# PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

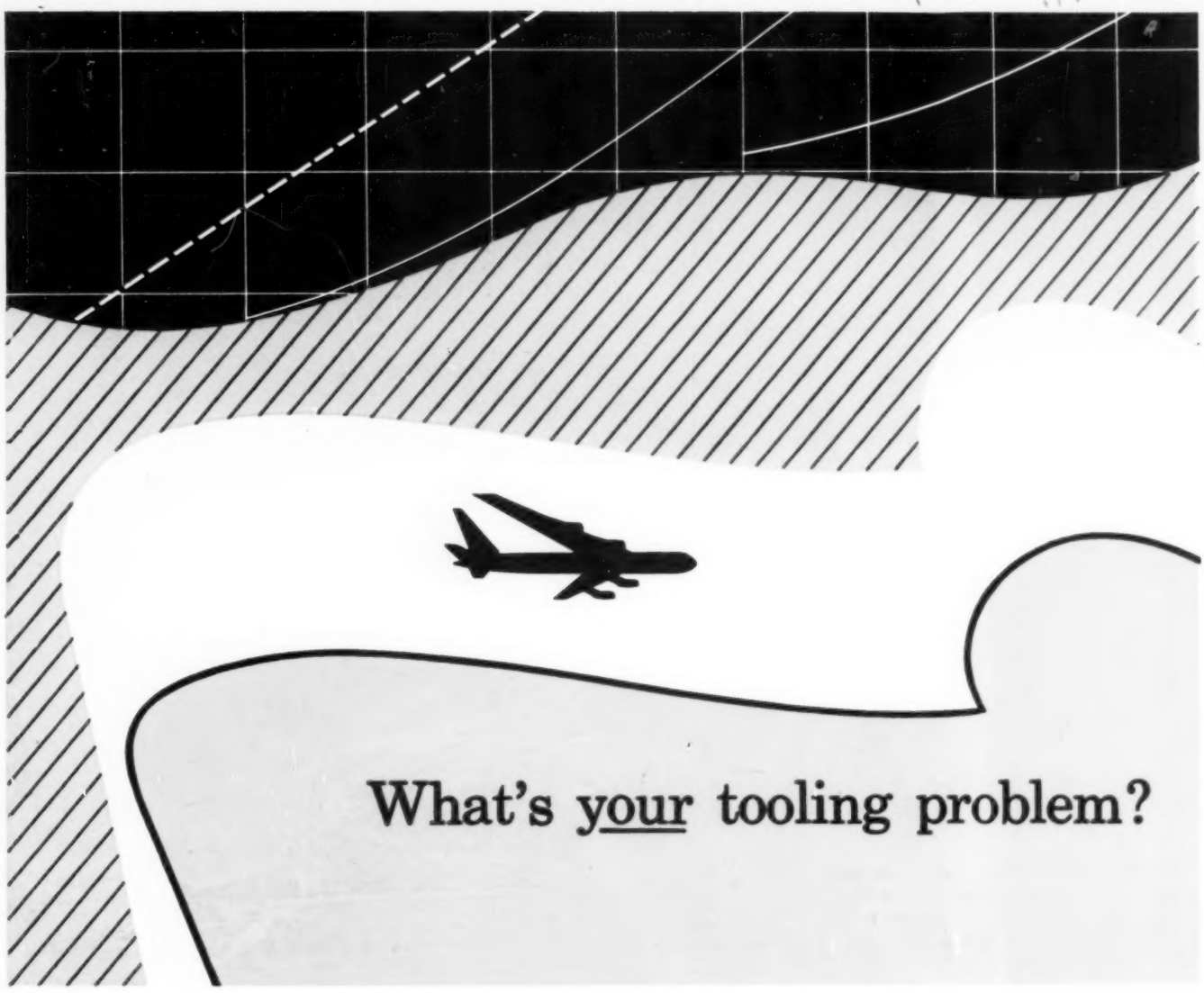
JULY 1958

POLYETHYLENE CONVEYOR SYSTEM IN USE AT WESTERN ELECTRIC'S POINT BREEZE WORKS

See Feature Story/page 652

A BILL BROTHERS PUBLICATION

TP986 .A1P529




## Your tooling resin formulator can help you with **EPON® RESIN**

The skill and knowledge of your tooling resin formulator combined with Shell Chemical's years of experience and technical research mean more profitable production for *you* with Epon resin tooling.

In addition to supplying basic tooling information, Shell Chemical also has developed extensive data on fillers, flexibilizers, curing agents, and diluents for your tooling resin formulator.

In many fields of industry, the unusual physical properties of tools made with Epon resin-based formulations make possible the saving of more than half the cost of fabricating a conventional tool.

**High temperature tooling.** Both metal and plastic forming tools, capable of operating at temperatures between 400°F. and 500°F., can be made with Epon 1310.

**Long-lasting metal forming tools.** Test results show that a casting of an Epon resin formulation mounted in a crank press and subjected to repeated blows had no permanent deformation after 28,000 cycles.

**Excellent tolerances.** Little machining and handwork are required to finish Epon resin tools, because the material can be fabricated to very close tolerances.

**Outstanding strength.** Tools with thin cross sections can be laminated with layers of glass cloth and Epon resin to achieve high flexural strength.

Can Epon resin help you with your tooling? Find out now by writing your tooling resin formulator. For a list of tooling resin formulators, write to Shell Chemical.

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THE LIBRARY OF CONGRESS SERIAL RECORD
AUG - 5 1958

Florida's damp salt air doesn't harm these attractive lamps. They never need painting. MARLEX *won't rust!*

JUL 23 1958

Home in the new Coral Key Villas section near Pompano Beach, where more than 120 Cape Codder lanterns are installed, and 690 are planned.

CAPE CODDER LANTERN MADE BY ENGINEERED PRODUCTS, INC., KIRKWOOD, MO.

# A revolutionary, new lantern that can't crack, peel, or rust even in salt air because it's made of MARLEX*

RIGID POLYETHYLENE

"Damp salt air and intense sunshine are tough on most materials. We think MARLEX is just the ticket for these difficult conditions," says George O. Palmer, Owner, Palm-Aire Construction Company, Pompano Beach, Florida. "MARLEX is a durable plastic that can take plenty of punishment. Lanterns made of it stand up well in all kinds of weather."

Every day MARLEX is finding its way into new uses. In many cases this premium quality rigid polyethylene is the least expensive material that can meet manufacturers' strict specifications.

MARLEX is highly versatile, too. It can be molded into attractive colorful housewares or used in many heavy duty industrial applications. It can be extruded into tough film or filaments. It's odorless, tasteless . . . can be steam-sterilized . . . is unaffected by most acids, alkalies, and oils.

For full information, call your nearest MARLEX sales representative.

*MARLEX is a trademark for Phillips family of olefin polymers.

**PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma**
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# PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

JULY 1958 VOLUME IV, NUMBER 7



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The effects of such variables as curing time and temperature, laminating pressure, and resin content are investigated.

636 **REINFORCED PLASTICS PREFORMING WITHOUT DISCOLORATION** *R. E. Mollman*
A case study of discoloration problems and their successful prevention or cure.

640 **NEW STYRENE FOR PLASTICS LIGHTING FIXTURES** *R. A. McCarthy*
Available accelerated light-exposure tests and discoloration factors are compared and discussed as the basis for evaluating Luxtrex "perma tone" styrenes.

644 **ENGINEERING ASPECTS OF POLYSTYRENE** *P. H. Estes, III*
A comprehensive review of material types, factors affecting physical properties, stress considerations, and injection molding design principles.

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The opinions expressed by our contributors do not necessarily reflect those of our editors

# Letters to the Editor

## Previews of Next Month

The following articles will be published in the August issue:

**Extrusion of Rigid Polyethylene Pipe.** L. B. Croley and Robert Doyle, Phillips Chemical Co., Bartlesville, Okla.

**Adhesive Bonding of the Newer Plastics.** M. J. Bodnar, acting chief of Adhesives Unit, and W. J. Powers, acting chief, Plastics & Research Section, Picatinny Arsenal, Dover, N. J.

**Fabricating the Structural Components of the All-Plastic "House of the Future."** C. G. Cullen, project engr., Winner Manufacturing Co., Trenton, N. J.

**Flexible Epoxy Resins.** W. J. Belanger, mgr. of Plastics Tech. Service Lab., and H. C. Klassen, sales mgr., Plastics Resins, Jones-Dabney Div., Devoe & Reynolds Co., Louisville, Ky.

•

## Highlights of this Issue

**Physical Properties of Prepreg Laminates.** (p. 631)

Designed to aid the engineer and designer to a better understanding of prepreg, this paper discusses the effects on laminate properties of such variables as curing time and temperature, laminating pressure, and resin content.

•

**Reinforced Plastics Preforming Without Discoloration.** (p. 636)

A discussion of discoloration problems in preforming, and their successful prevention or cure. Factors covered include resin binder, preform oven, curing timer, preforming machine, contaminants encountered in preforming, and resin, filler, and pigment materials available.

•

**New Styrene for Plastics Lighting Fixtures.** (p. 640)

Lustrex "perma tone" styrenes are evaluated on the basis of test results obtained in accelerated light-exposure tests. Available test methods are discussed and compared for use in judging plastics for lighting applications.

•

**Engineering Aspects of Polystyrene.** (p. 644)

A definative review of available polystyrene types, including general-purpose, shock-resistant or impact, chemical-resistant, and fiber-filled types. In addition to properties of the different types, emphasis is placed on design fundamentals, stress considerations, and proper understanding of injection molding design.

### Disposable Wiping Rags

Dear Sir:

We are trying to reach a market comprised of businesses in need of disposable wiping rags, and would like to know if the industry covered by your publication would have enough sales potential to make it worthwhile for our client to consider expanding his manufacturing and selling operations.

If your publication does reach such a market, could you answer the following questions?

Who does the buying?

Where would a product of this type normally be purchased?

How much would these purchasers be willing to pay for such an item?

Any information you can furnish will be greatly appreciated.

*(Identity Withheld)*

*(Any information that our readers may furnish will be forwarded gladly to the inquirer. We would suggest, however, that "guessimates" be identified plainly as being educated guesses.—Editor)*

• • •

### Lab Weathering Tests Questioned

Dear Sir:

Artificial laboratory tests, insofar as weathering and sunlight are concerned, do not always accurately portray true actual service performance. As a matter of fact, we know very little relatively about solar radiation and the effect it has on various kinds of materials.

"Synthetic" sunshine cannot replace actual sunlight. In addition to light, many materials react differently under various humidities, heats, and other environments. Actual weathering is very difficult to reproduce in a laboratory. There are conditions of dew, rain, thermal shocks, wind and other factors all combined with solar radiation to cause failures which are not present in artificial tests.

*E. M. DeNoon, Tech. Dir.*
*South Florida Test Service*
*Miami, Fla.*

• • •

### Corrects Our Reply

Dear Sir:

The information which you gave in your June 1958 issue in answer to a letter to the Editor captioned "Copies of Foreign Articles" is no longer correct.

The photocopying service performed by the American Chemical Society, in cooperation with the U. S. Department of Agriculture library, was discontinued in June 1957.

The best single source of information on foreign, as well as American journals is contained in the "List of Periodicals Abstracted by Chemical Abstracts" published in 1956, and the supplement issued in 1957. These publications, available from The American Chemical Society, Special Publication Department, contain detailed listings of all important technical journals, and a summary of the libraries in North America which receive these journals. These libraries are separately listed and identified as to those which will prepare microfilm or photoprint copies, normally at reasonable cost, as well as perform other services.

*M. T. Musgrave, Asst. to Res. Dir.,*
*Acheson Industries, Inc.*
*Port Huron, Michigan*

*(We gladly stand corrected, and wish to thank the writer for his courtesy in correcting our error.—Editor)*

• • •

### Hoover Reports

Bill Brothers:

We have been aware of the fine support your publications have been giving the Hoover Reports. You are doing some very effective work for a good cause, and your organization is to be congratulated.

*E. B. Steele, Manager*
*News & Information Dept.*
*Chamber of Commerce of the United States*
*Washington, D. C.*

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

## "Quote . . . Unquote"

### *Industry's Changing Needs*

"The most conspicuous change in the industrial world has been its increasing technological complexity. Twenty years ago the most advanced business machines . . . could do nothing which could not be done by human computers—they could only do it more quickly. Today, on the other hand, we can build and are using electronic devices capable of solving intricate mathematical problems which could not be attempted without them. Many other examples will occur to you.

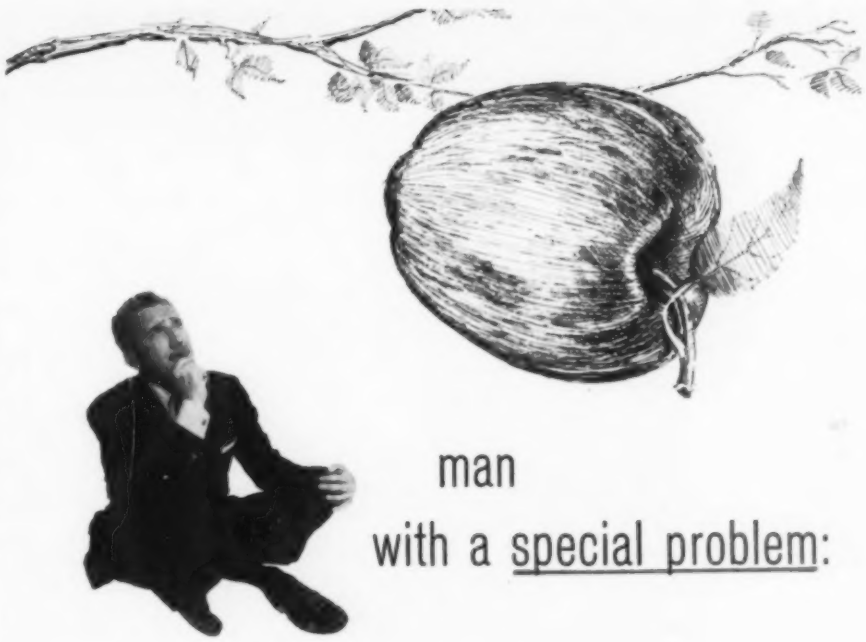
"With the growth in technological complexity, and in large part as a result of it, our industrial machine has become highly instrumented and mechanized. Again, as an outgrowth of these technological advances, we have pushed toward higher and higher speed in our industrial operations. Oftimes, the pace has advanced to the stage where the hand is not only quicker than the eye—our machine speed may be faster than both.

"With the change in the speed of our operations, there has been an increase in the rate of change itself. Today, most companies are supporting intensive research and development programs in the physical sciences and technologies dependent upon them. Such researches are leading to improved methods, improved processes, and improved products—to such an extent that in some industries plants are being obsoleted almost as rapidly as they are being built.

"This high rate of obsolescence resulting from extensive research has resulted in heavy capital expenditures for new plants by industry. As our industrial plant becomes more involved, as the amount of capital per worker has increased, as the training and skills required to operate the machinery have grown, we find the association of the worker with the producing enterprise growing closer and closer. Workers must often be uniquely qualified and trained for a given task. Less often can we replace a worker from the pool of available skills without a long and intenive training program specifically designed for the man and the job.

"As this closeness of association between an industrial enterprise and its workers has grown, more use has been made of plans aimed to protect the welfare of the employee and his dependents throughout, and even after, his working career. Such plans may be expected to become more widespread because they are basically sound in an industrial world which must require of its workers unique skills and training to operate its complex, rapid, and high-cost facilities."

*D. H. Dawson, Vice Pres. & Director*
*E. I. du Pont de Nemours & Co., Wilmington, Del.*

man
with a special problem:

NEWTON solved *his* problem with a Mackintosh (some say it was a Jonathan). There's a key to *your* special problem, too—important thing is to be able to spot it when it drops into your lap. Busy designers and manufacturers today are wise not to wait for that unlikely event. For example, to find the phenolic molding compound that best answers their particular need . . . unusual as it may be . . . they go directly to the *specialists* in such problems. They consult with Plenco.

AT PLENCO, your special needs are given the special attention they require. Quite often that means designing a new formulation or a new combination of thermosetting phenolic materials specifically suited to meet your product or production problem. Plenco is ideally set up to produce such *special-purpose* molding compounds.

For, to our way of thinking, the versatility and value of phenolics is bounded only by the experience and initiative that goes into their production . . . and into the preliminary discussion of the problem. We've proved that again and again. We'd like to prove it to you. *If phenolics can do it . . .* ready made *or* custom made . . . *Plenco can provide it.*

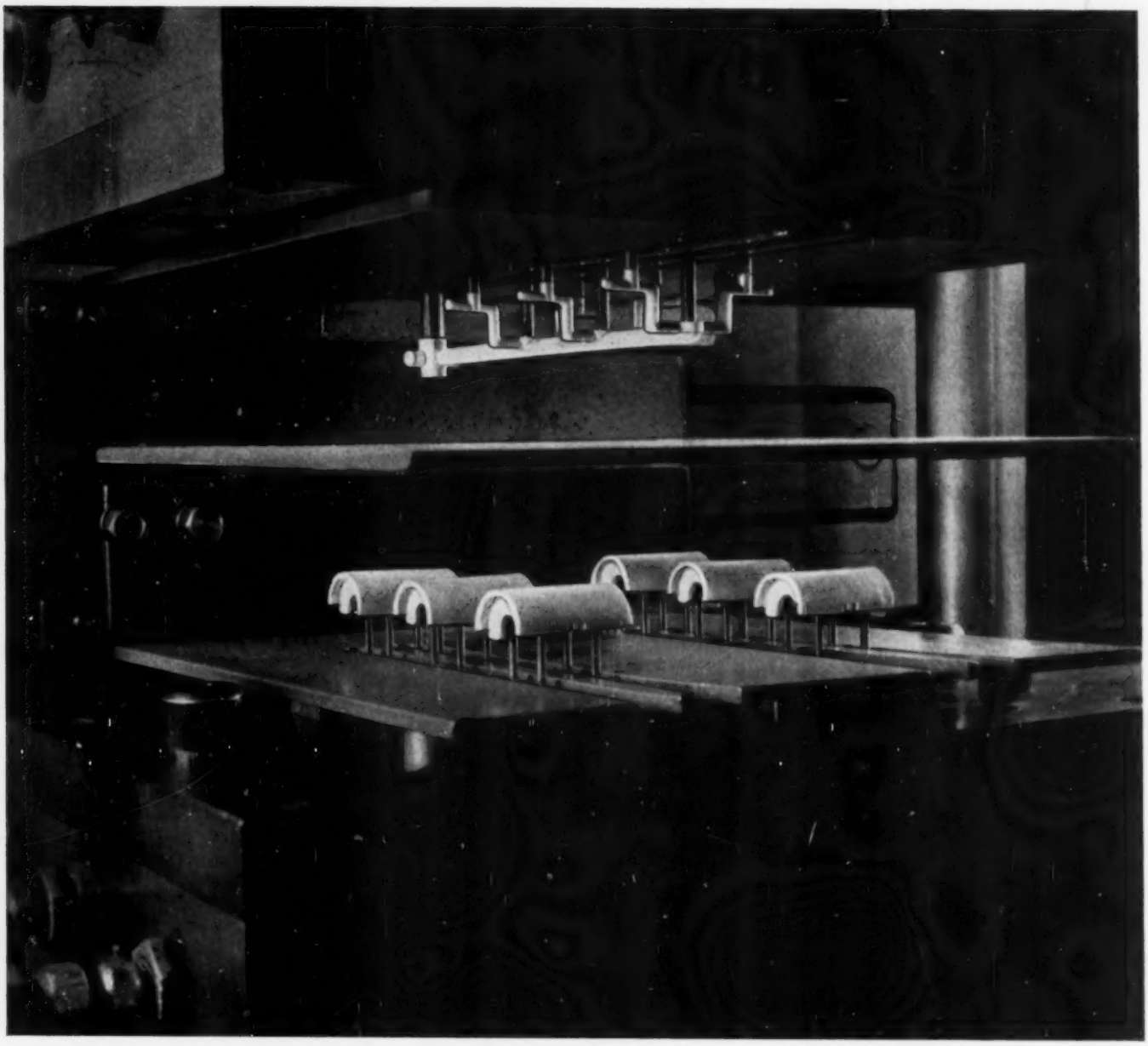
PLENCO
phenolic molding compounds

**PLASTICS ENGINEERING COMPANY**

Sheboygan, Wisconsin

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.



# this is POSITIVE EJECTION*!

Positive ejection is essential to "all-the-way" injection molding. Stokes injection molding machines feature this exclusive operation that enables fully automatic degating and sorting—and even automatic handling of scrap. Manual set-up and occasional monitoring are the only attentions required by Stokes machines.

The Stokes Advisory Service will supply complete data and application information—and, if desired, a production analysis on your own parts requirements.

*In truly automatic injection molding

*Plastics Equipment Division*
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

**STOKES**

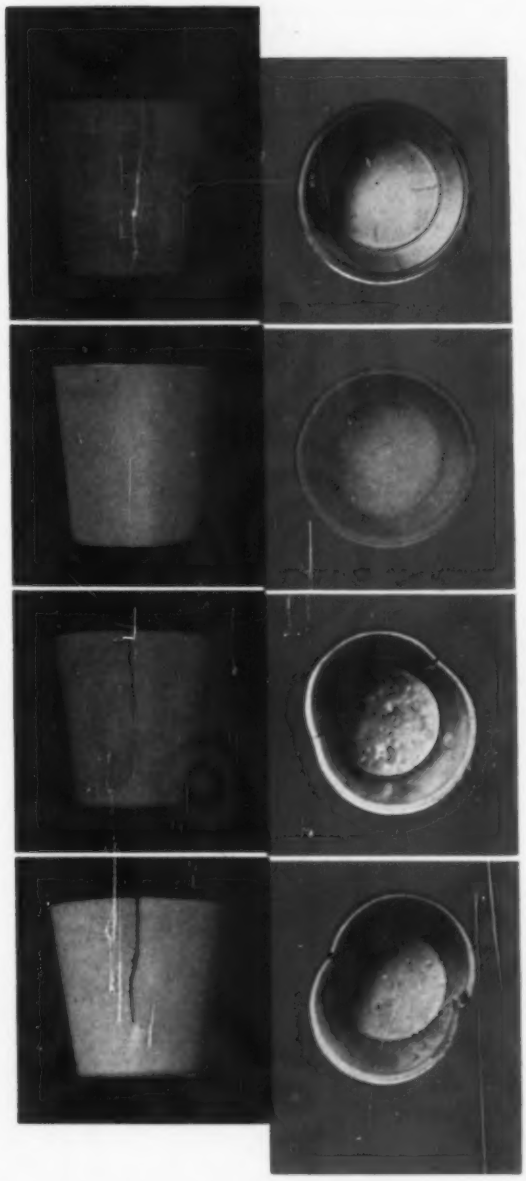
UNRETOUCHED PHOTOS

# DRAMATIC PROOF ▶

## of DAPON® resin's outstanding stability under heat and humidity

As graphically shown here, Dapon Resin does not distort, degrade or discolor under long exposure to high heat and humidity. This outstanding dimensional stability, coupled with Dapon Resin's high electrical properties and chemical stability even under extreme conditions, may provide the answer to your high-temperature high-humidity plastics stability problems.

Dapon Resin is easily compounded with a wide variety of mineral and fibrous fillers and has extremely low molding and post-mold shrinkage. And in addition, Dapon Resin can be molded in a range of solid and pastel colors.



**MELAMINE "A"**
after 10 days under test

**DAPON**
after 90 days under test

**POLYESTER "A"**
after 18 days under test

**POLYESTER "B"**
after 22 days under test

**TEST DATA:** An equal number of test cups were molded under normal conditions from commercial polyester, melamine and DAPON Resin. The cups were half filled with tap water and placed in a laboratory oven at a constant 212°F temperature, the water being replaced daily. The cups were examined at regular intervals and removed from the oven when they had reached the condition shown in the unretouched illustration.

*At your request, we will be glad to send you complete technical data on Dapon Resin so that you can investigate this unusual plastic as the answer to your specific problems.*

**Properties of DAPON* Resin**

Stable, free-flowing white powder • Easy to store, easy to mold, easy to color • Molded products have excellent surface finish • Good physical strength • Low moisture absorption • Chemically resistant • High-temperature and high-humidity resistance • Outstanding dimensional and chemical stability • Fine electrical properties even at high-temperature and high-humidity.

**DAPON Resin is the registered trade name of Food Machinery and Chemical Corporation's brand of diallyl phthalate prepolymer.*

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*Putting Ideas to Work*

FOOD MACHINERY AND CHEMICAL CORPORATION

**Chemicals and Plastics Division**

161 EAST 42ND STREET, NEW YORK 17, N.Y.

**The lighter side of rubber and plastics** . . . colorwise, of course . . . is achieved through the rutile titanium dioxides TITANOX*-RA, TITANOX-RA-50, and TITANOX-RA-NC.

Here's why: these leading white pigments lighten and opacify colors, whiten and opacify white stocks, regulate translucency or opacity, and contribute to durability. In addition, they lighten the burden of processing through ease of dispersion and uniformity of all properties. Our Technical Service Department can help you with any pigmentation problem. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities.

5721

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*Subsidiary of* **NATIONAL LEAD COMPANY**

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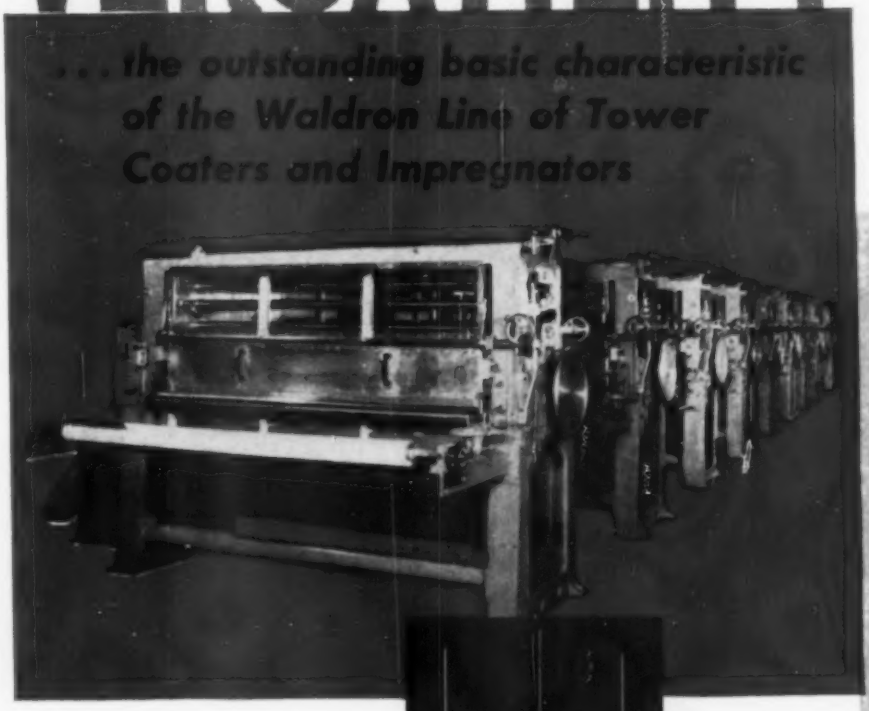
# VERSATILITY

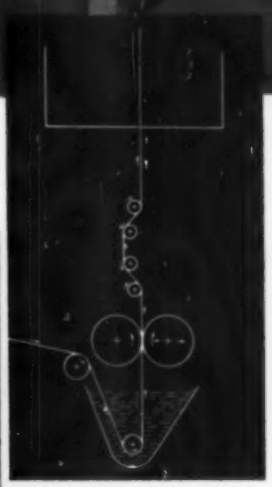
## . . . the outstanding basic characteristic of the Waldron Line of Tower Coaters and Impregnators

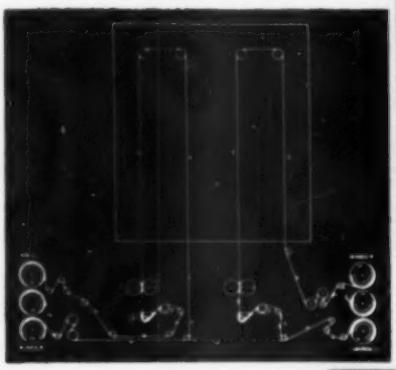


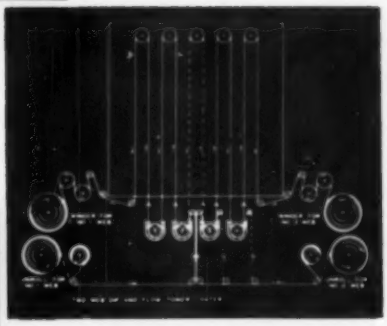
**For surface coating webs made of non-permeable materials such as glassine, cellophane and other films.**

**For impregnating webs made of synthetic fibers (nylon, glass, rayon, etc.) with the silicones, phenolics, polyesters and melamines.**

**For impregnating webs made of natural fibers such as paper, with phenolics, ureas and melamines.**







The basic design is the same for all; details are changed to meet the individual requirements imposed by the coating or impregnating ingredients and by the material being treated. The records of the many Waldron Tower Coaters in use show consistently this common value: uniform coating or impregnating without wrinkling.

It might be a good idea for you to trust your future products to a Waldron Tower Coater. Why not discuss your requirements with a Waldron Web Processing specialist?

THE MIDLAND-ROSS GROUP OF COMPLEMENTING SERVICES

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# NEW 2 RIGID For pipe

**These rigid vinyl compounds just announced by Bakelite Company *outperform any other rigid vinyl on the market today!* Greater resistance to chemicals—better heat stability—*as much as 100% faster extrudability, with better surface smoothness*—all these, and other advantages are offered by both materials.**

**QGD-5020, a modified Type II rigid vinyl, offers a new, high impact strength, making it *one of the toughest plastic materials commercially available.***

**Both materials are exceptionally free-flowing. QGD-5010, with outstanding chemical inertness, will find widest application in commercial and industrial corrosion-resistant pipe.**

**In addition to standard pipe applications, the QGD-5020 compound is a superior general purpose extrusion material for contour applications such as channels and framing members for windows and storm sash, electrical conduits, down spouts and gutters, fountain pen and automatic pencil barrels, and many more!**

★ ★ ★

**Complete details on both compounds are given in new technical bulletins. Write today to Dept. PT-32.**

# VINYL COMPOUNDS

## and all-purpose extrusion

# Extrudability!

| TYPICAL PROPERTIES | QGD 5010 | QGD 5020 |
|---|---|---|
| Specific Gravity | 1.38 | 1.313 |
| Heat Distortion, deg. C. | 70 | 69 |
| Izod Impact | .6 | 24 - 30 |
| Rockwell "R" | 115 | 107 |
| Tensile Strength, psi | 8500 | 6500 |
| Elongation, % | 50 | 30 |
| Flexural Strength, psi | 11,800 | 10,000 |
| Flexural Modulus, psi | 450,000 | 357,000 |
| Chemical Resistance, 30 day immersion test | | |
| in $H_2SO_4$, % change in flex. str. | + 9.94 | + 3.8 |
| in $H_2SO_4$, % change in wt. | + .08 | + .452 |
| in Glacial Acetic Acid, % change in flex. str. | — 42.7 | — 68. |
| in Glacial Acetic Acid, % change in wt. | + 7.41 | + 17.8 |

**BAKELITE**
BRAND
**RIGID VINYLS**

*Products of* UNION CARBIDE *Corporation*

**BAKELITE COMPANY,** *Division of Union Carbide Corporation,* 30 East 42nd Street, New York 17, N. Y.
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# Quality Dispersed Colors Cost Less

Color quality in your finished product depends on *fine and uniform dispersion.* The finer the dispersion, the better the color.

**adp** quality dispersions make quality products.

**adp** dispersed colors are uniformly fine so your pigments extend further . . . you save in the cost of dispersion, in the cost of compounding, in the cost of rejects and returns.

**adp** dispersed colors, with reasonable compounding, give uniform extensibility without streaking.

**adp** *Controlled Colors* have characteristics of fineness and uniformity unmatched in dispersions made by ordinary methods.

**adp** colors come true on every re-order, each a precise duplicate of the specified standard.

**adp** specialists will be glad to help you with *your* dispersion problems.

**CONTROLLED COLORS BY** adp

**ACHESON Dispersed Pigments Company**
**1421 Chestnut Street, Philadelphia 2, Pa.**

**A Unit of Acheson Industries, Inc. Plants at Orange, Tex., Philadelphia, Pa., Xenia, O.**
**West Coast Distributor: B. E. Dougherty Company, Los Angeles 21, California**
**In Europe: Acheson Industries (Europe), Ltd., 18 Pall Mall, London S.W. 1, England**

PLASTICS TECHNOLOGY

JULY, 1958

# EDITORIAL: "Achievement Awards" Program Reminder

Our first annual competition program on "Achievement Awards for Plastics Technology" started on April 1st. This first program, for 1958-59, ends on March 31, 1959, and the winning entries will be announced and fully publicized in the April 1959 issue.

This program consists of two categories:

(1). New developments in plastics processing. This includes all methods whereby a plastic material, as furnished by a materials supplier, is molded, extruded, calendered, formed, or otherwise shaped into a finished or semi-finished form.

(2). New developments in plastics fabricating. This includes assembly operations, decorating, bonding, or other methods whereby a semi-finished part is converted or otherwise transformed into a finished product.

•

The final Award winners in each category will receive suitable plaques, but, of greater importance, will be described in a manner befitting their importance as major advances in the technological processing or fabricating, respectively, of plastics that will benefit the continued advance of the plastics industry, with resultant progress in all fields of application for the good of everyone.

It should be noted that this program entails a change from the original announcement. We had previously expected to announce and publicize monthly winners in the two categories and, at the end of the yearly program, select the grand award winners from this group of monthly selections. Under the revised program, and this is the final change that will be made, the grand award winners and "honorable mentions" will be announced and duly publicized at the end of the program year—in the April 1959 issue of our magazine.

The winners and "mentions" will be described in detail and fully illustrated, with due recognition of the persons responsible for the developments and the companies involved, not to mention emphasis on the engineering importance of each development.

Not to be overlooked is another important by-product to each entrant and his sponsor. Exhaustive records are kept in our office on the dates and other particulars of each entry and, as a consequence, provide an authoritative record that will prove valuable to each development. In these times of mistaken and short-sighted "secrets" in the plastics processing and fabricating industry that are busily ferreted out, emulated, and then claimed as "firsts" by the copiers, this is an advantage not to be gainsayed.

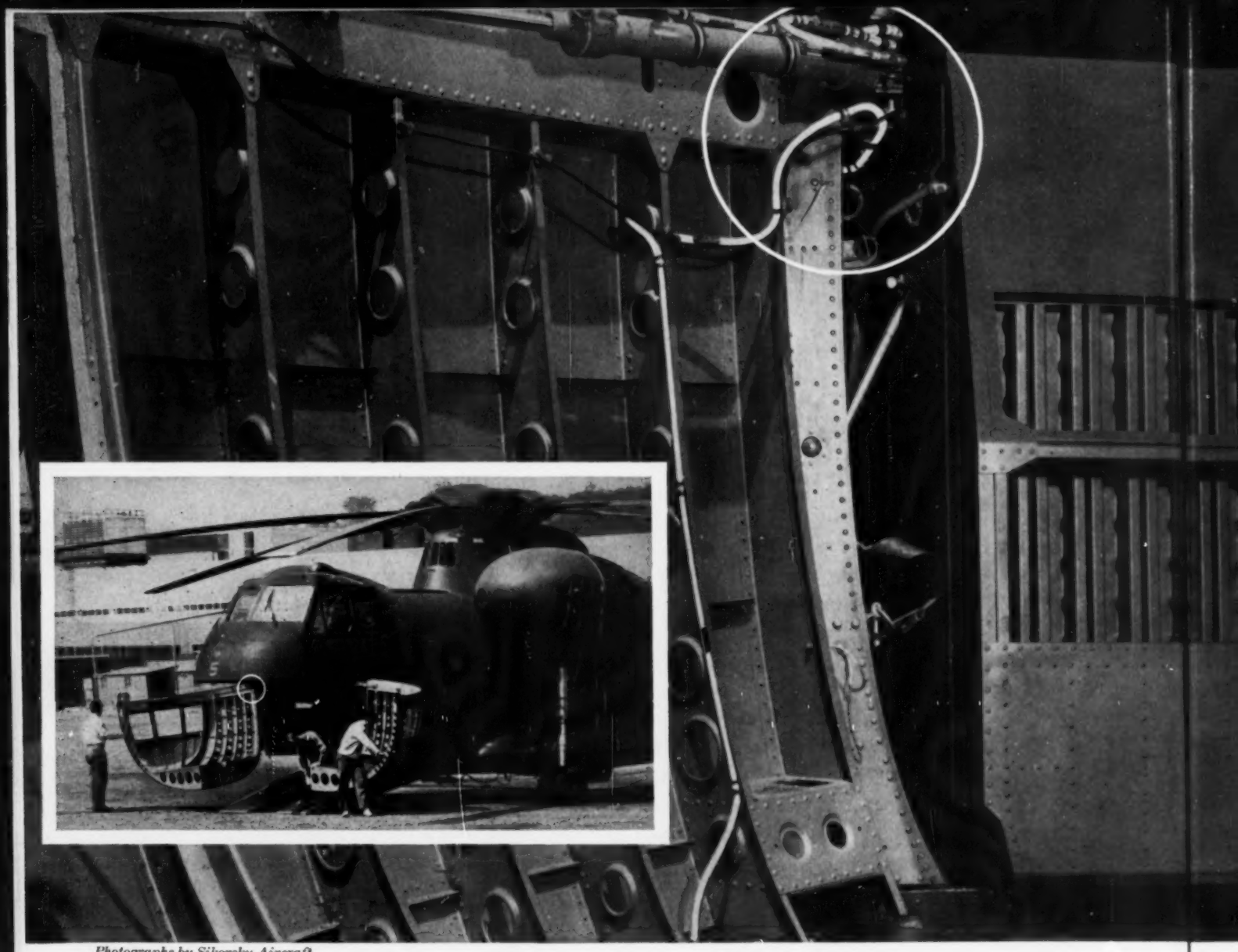
•

The rules for the "Achievement Awards" competition are simplicity itself; no formal forms need be submitted. To enter, just notify us, in writing, giving a brief description of the development. Then, after due consideration, we will contact each writer for any further information needed for a true evaluation of the development.

That's it. Now, may we hear from you?

Arthur M. Merrill

Editor



*Photographs by Sikorsky Aircraft*

**Heat is high, space is limited, bends are sharp** in today's complex electrical systems. In the S-56 helicopter, for example, cables snake through engine compartment, squeeze by cherry-red manifolds, loop over hinges to reach landing lights in clam shell doors. For this and comparably destructive environments, wire makers seeking to develop vinyl insulation with appropriate properties in thin section need better heat stabilizers . . . stabilizers with excellent dispersion, improved moisture resistance . . . stabilizers that provide greater volume resistivity, greater insulation resistance.

# Dutch Boy® stabilizer research h vinyl insulation tougher, more h

These photographs show how National Lead research helps vinyl producers in one field . . . electrical insulation . . . overcome difficult stabilization problems and so broaden the market for their products.

National Lead researchers do as much and more for producers of many additional vinyl products. Recently, for example, they came up with "Dutch Boy" stabilizer, Temex 3. This unique stabilizer provides both stabilizing and chelating action . . . greatly aids performance of vinyl flooring. Eighteen other "Dutch Boy" stabilizers boost the life or improve the usefulness of other vinyl products.

Get acquainted with useful, versatile "Dutch Boy" Chemicals. Write for handbook.

**Researcher looks for tell-tale white in colored sample of proposed insulation.** In this test, National Lead technician confirms that "Dutch Boy" stabilizer recommended for customer's proposed new thin vinyl insulation disperses properly. Improper dispersion would be signalled by white specks on background green of sample. Excellent dispersion is a principal reason for the wide use of "Dutch Boy" stabilizers when vinyls undergo very high heat in process or use and when maximum available stabilization action is needed.

**Oven separates "men" from "boys".** In this oven, researchers age various insulation compounds at slightly above service temperatures. Then they condition the compounds for one hour at 95°C and, at the same temperature, measure their volume resistivity. Aim of test is to determine compounds that will maintain maximum electrical resistivity. In the run shown above, "Dutch Boy" Dythal® stabilizer gave best results. This stabilizer does well in 8-mil, 105°C wire.

**Immersion proves "Dutch Boy" stabilizer resists water and protects insulation.** Using standard Underwriter's procedures, National Lead technicians put a customer's experimental high temperature insulation through water-immersion test. Commercially extruded wire is tested in 50 to 500 foot lengths. It must go weeks at voltage, show less than 10% resistance loss from all causes . . . including water absorption or scoring of thin coating by oversize particles that might have stuck in die. When properly stabilized with "Dutch Boy" stabilizers, thin stocks pass this test easily.

**Insulation breakdown test at ½ of service thickness completes tests.** After determining the most suitable stabilization for a proposed compound, National Lead is sometimes asked to run an insulation breakdown test. For this test, lengths of wire are produced by the customer with the insulation at ½ service thickness. Here you see a run in progress on 8-mil, 105°C stock protected by Dythal stabilizer. Better performance than ever before is now being obtained in thin, high temperature compounds. With further research, still higher values are expected.

# th helps make thin re heat resistant

**7 "Dutch Boy" stabilizers meet most vinyl insulation needs.** Each of these products of National Lead research is a commercially proved product. Among them, you'll find the right stabilizer for all electrical and a variety of other opaque vinyl products.

| | |
|---|---|
| Tribase* (Tribasic lead sulphate) | For high heat stability in vinyl electrical insulations. |
| Tribase-E* (Basic lead silicate sulphate complex) | An economical stabilizer for vinyl electrical insulation. |
| Lectro*60* (Lead chlorosilicate complex) | Low vol. cost stabilizer for electrical insulation. |
| Lectro*77 (Lead chlorophthalosilicate) | For a wide range of vinyl electrical insulation. |
| Lectro*78 (Tetrabasic lead fumarate) | Outstanding stabilizer for high temperature uses. |
| Dythal® (Dibasic lead phthalate) | Outstanding stabilizer for 105° C – class insulation. |
| Dyphos® (Dibasic lead phosphite) | Outstanding anti-oxidant, heat, light and weather stabilizer. |

* TRADEMARK

Dutch Boy CHEMICALS

**NATIONAL LEAD COMPANY,** 111 Broadway, New York 6, N. Y.
*In Canada:* CANADIAN TITANIUM PIGMENTS LIMITED
630 Dorchester Street, West • Montreal.

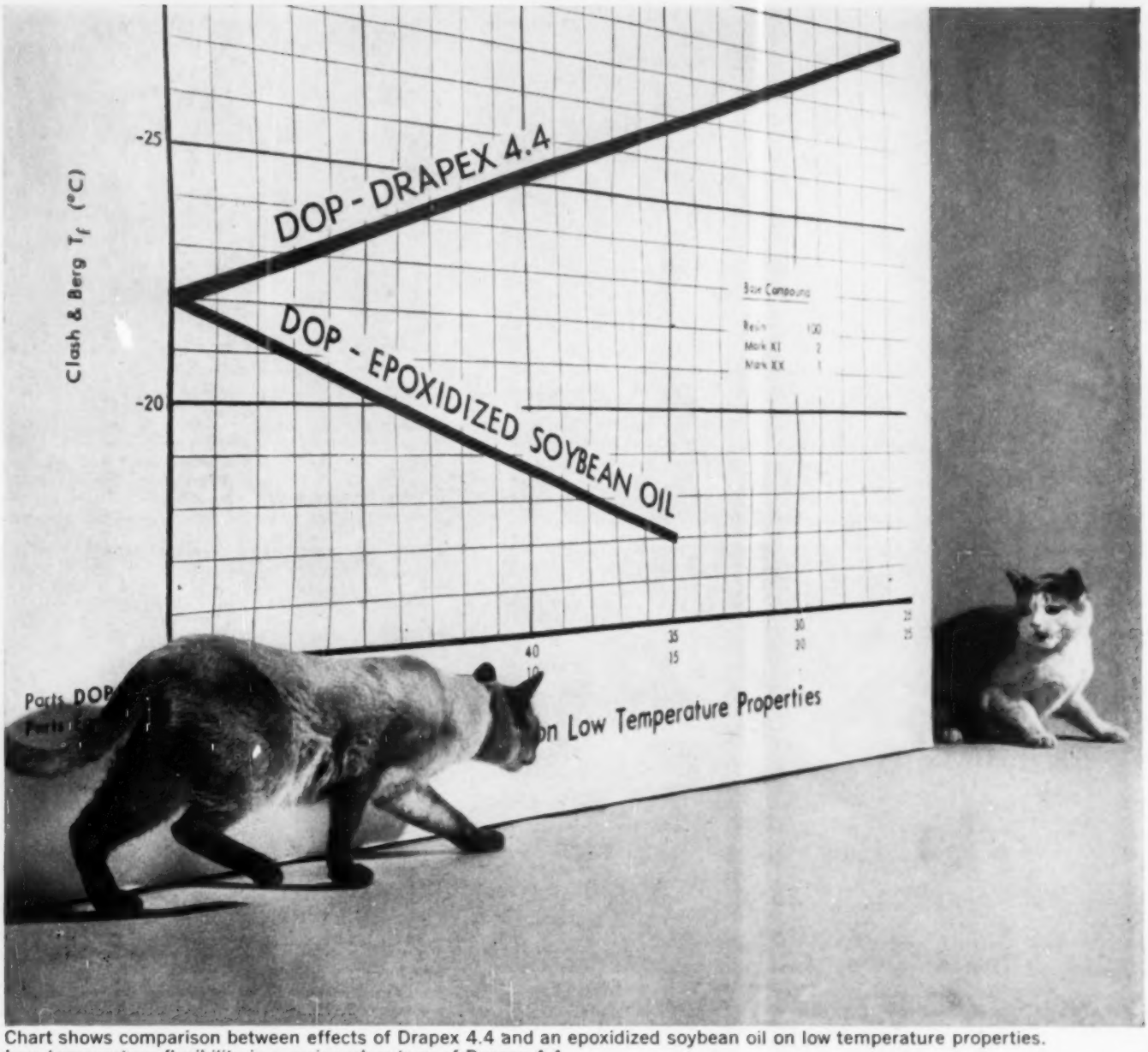



Chart shows comparison between effects of Drapex 4.4 and an epoxidized soybean oil on low temperature properties. Low temperature flexibility is a major advantage of Drapex 4.4.

# PURE-BRED EPOXY... AT AN ALLEY-CAT PRICE!

There's a blue-ribbon champion in epoxy plasticizers — Argus' Drapex 4.4! At its new, reduced price, you can replace ordinary epoxy plasticizers with Drapex 4.4 in your vinyl formulations, with the following important advantages:

1. **Low temperature flexibility (see chart above).**
2. **Low volatility.**
3. **Improved heat and light stability.**
4. **Low viscosity and viscosity stability in plastisols.**
5. **Ease of handling (due to low viscosity and low freezing point).**
6. **Good weatherability.**

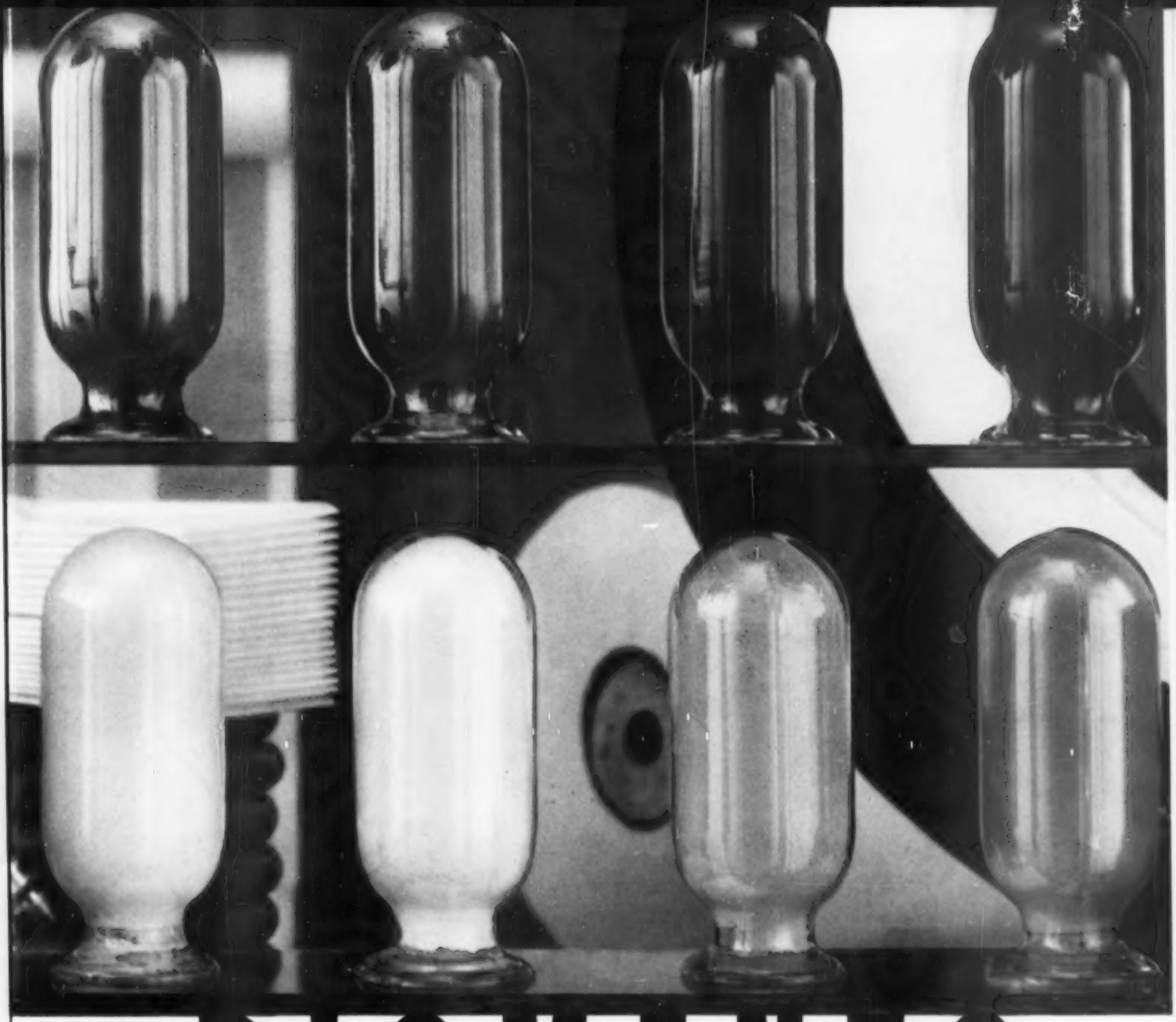
Argus research has steadily widened the applications of Drapex 4.4 until it now actually costs *less* than other quality epoxies. Moreover, the lower specific gravity of Drapex 4.4 makes it go farther, so that in volume use it costs less than the cheapest competitive epoxy.

For complete information on Drapex 4.4 (and its sister product, Drapex 3.2), write for Technical Bulletin #3.

**ARGUS CHEMICAL** CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N. Y. Branch: Frederick Building, Cleveland 15, Ohio

Rep's.: H. M. Royal, Inc., 4814 Loma Vista Ave., Los Angeles; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal.



# PIGMENTS

## How to get the whiteness or color brightness you demand for your plastic products

Glidden pigments are the answer. New *Zopaque* Titanium Dioxide imparts greater lasting whiteness, permits brighter, cleaner tints. Finer, more uniform particles disperse much faster, more easily than ordinary pigments. Millions of tiny crystals scatter light like diamonds, assure highest opacity.

Non-fading, non-bleeding Glidden *Cadmolith* (cadmium-selenium) Reds and Yellows plus new *Mercadmolith* (cadmium-mercury) Reds provide everything you need to give your products maximum color appeal. They are soft, easy to grind, insoluble in all vehicles, and high in heat resistance.

Be sure to specify Glidden—a leading supplier of finest pigments to industry.

*By the makers of Sunolith Lithopones . . . Euston White Lead . . . Resistox Copper Pigments*

**THE GLIDDEN COMPANY**

Chemicals • Pigments • Metals Division

Baltimore, Maryland • Collinsville, Illinois • Hammond, Indiana • Scranton, Pa.

QUALITY Glidden PRODUCTS

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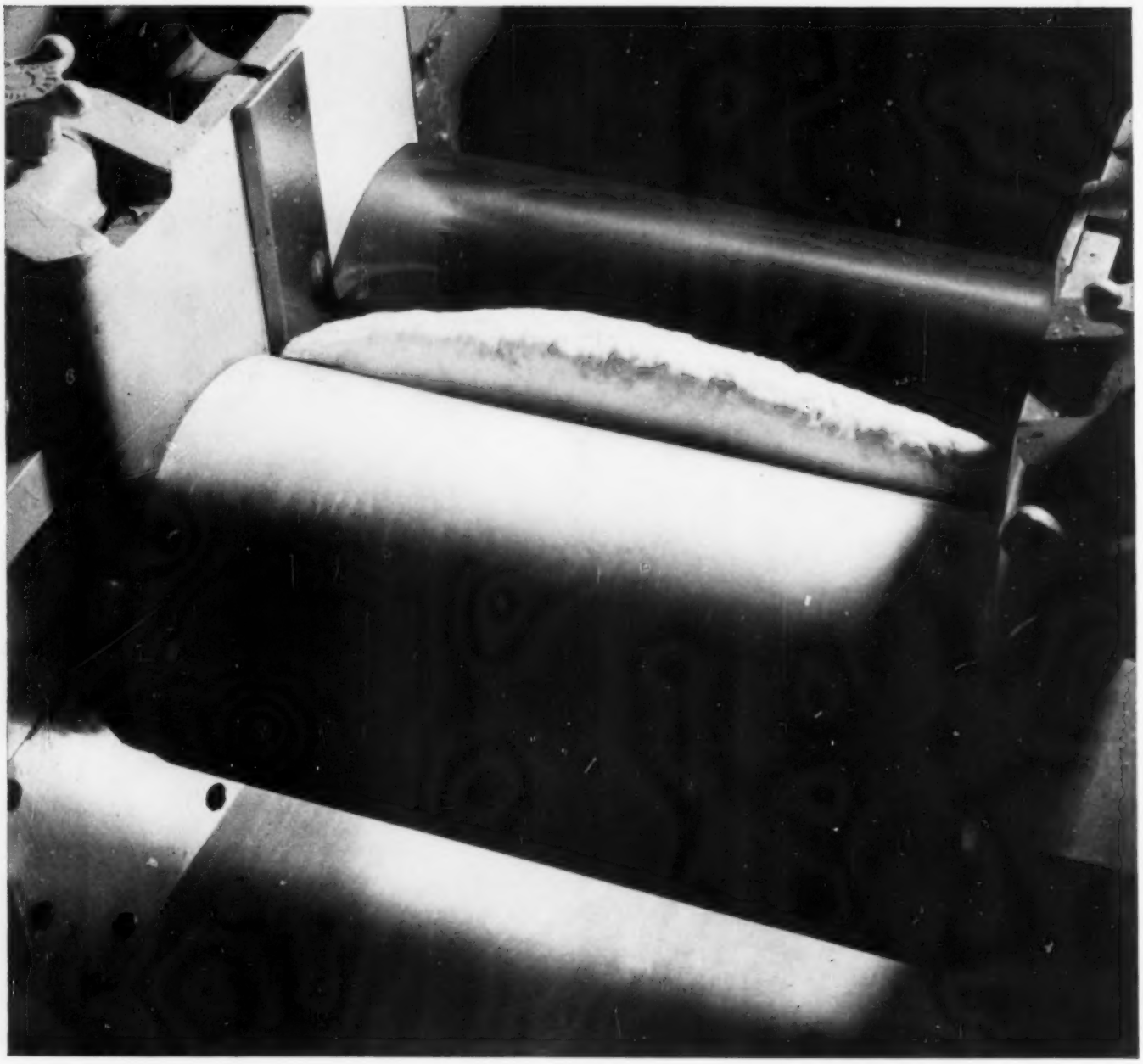


# NOW — fluid banks, no tear with Diamond PVC-30

**Look at this sheet** on the mill! Note especially the smooth surface, the smooth-flowing rolling bank, the absence of ragged edges. Result: faster, more economical production of calendered sheeting . . . now possible with compounds that contain Diamond's NEW PVC-30, latest addition to a growing family of low molecular weight PVC resins.

Diamond PVC-30 can replace copolymers you may be using now as processing aids. It costs less, has better heat stability, retains high flow characteristics . . . giving you faster, more economical processing at lower temperatures.

Other low molecular weight resins from Diamond are PVC-35, recommended for injection molding compounds at moderate temperatures; and PVC-40, recommended for rigid and flexible sheeting which provides the best balance between physical properties and easy processing.

For more information, write Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

JULY
1958

DOW

# Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

# PLASTICS MATERIALS ANALYZED BY ACCELERATED USE TESTS

## DOOR SLAM TESTS DETERMINE BEST PLASTICS MATERIAL FOR REFRIGERATOR DOOR LINERS

Plastic door liners for refrigerators are subjected to considerable wear and abuse while in service. That's why it's so important to select a plastic which will not fail even after years of continuous service.

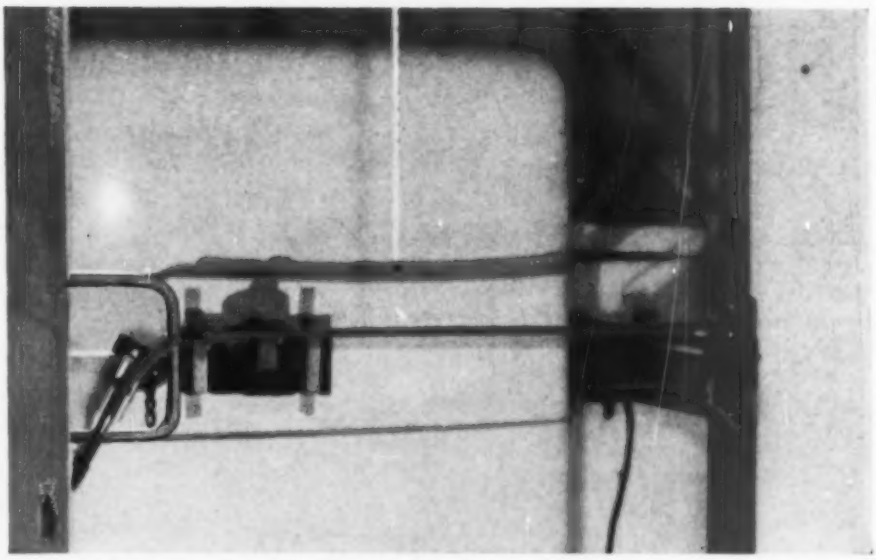
In an attempt to select the best material available for this particular application, Dow Plastics Technical Service Engineers utilize an accelerated-use test device.

Liners molded from various plastics to be tested are installed, one at a time, in a test refrigerator. (See photo at right.) The refrigerator is placed in a controlled temperature room and the shelves are weighted to capacity to simulate actual use conditions. Then a mechanical device which opens and shuts the door automatically is put into operation. It continues to open and close the door until the plastic fails. Failure is defined as the point at which the plastic cracks and the crack is visible to the naked eye.

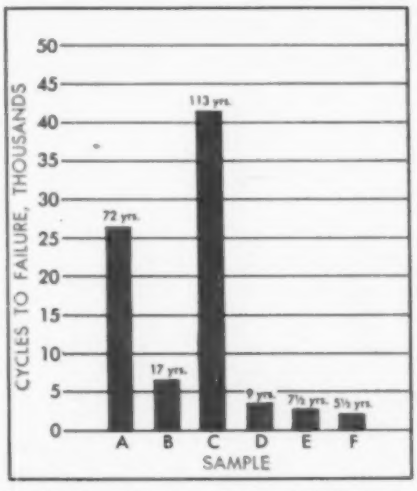
This test will quickly:

1 Select the best material for the application.
2 Provide data on the strength and weakness of a particular door liner design.
3 Define the life expectancy of a given door liner.

This test is but one of many continuing Plastiatrics studies conducted by Dow Plastics Technical Service Engineers. These studies cover every phase of plastics formulation, design, molding and finishing. This particular test has enabled Dow engineers to accumulate a wealth of information concerning correct design procedures. For your copy of the results or information on other areas under investigation, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 1523G.



Actual refrigerator in controlled temperature room where tests are conducted.




Results of accelerated-use tests on six different plastic formulations used for refrigerator door liners.

**AMERICA'S FIRST FAMILY OF POLYSTYRENES**

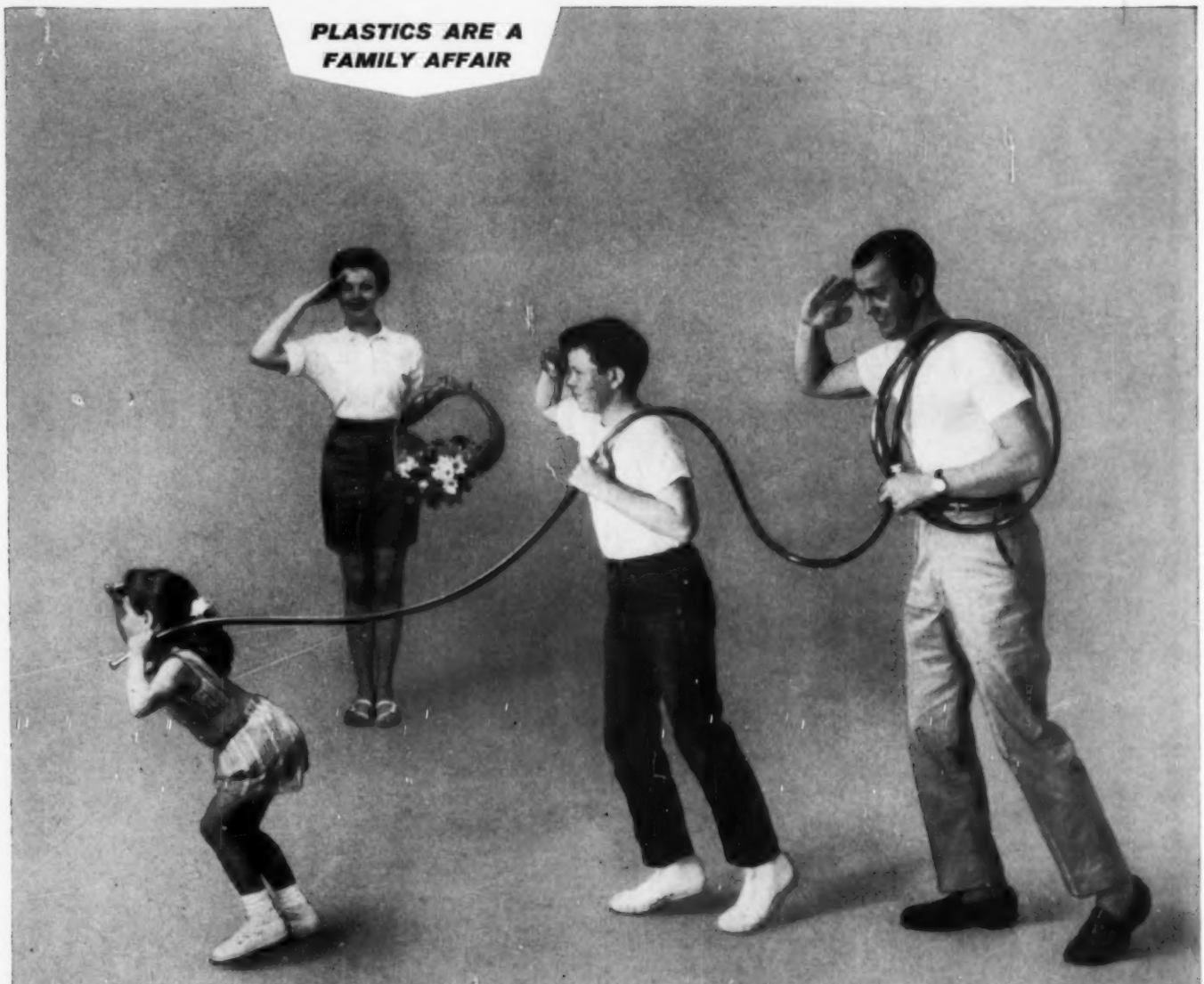
GENERAL PURPOSE
- STYRON ® 666
- STYRON 666M (Easy Flow)
- STYRON 665 (Extrusion)
- STYRON 689 (Easy Flow)

HIGH IMPACT
- STYRON 475
- STYRON 475M (Easy Flow)
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 440M (Easy Flow)
- STYRON 480 (Extra-High Impact)

HEAT RESISTANT
- STYRON 683
- STYRON 700

YOU CAN DEPEND ON DOW

***PLASTICS ARE A FAMILY AFFAIR***



# FRAGILE TOUCH TO A RUGGED EXTRUSION

Family frolicking gets gardening off to a good start.

It's just fun. They know there's no need to treat this rugged hose with such tenderness. Already – and many times – it's been dragged, kinked, pressured and forgotten in the sun. It's tough! It's quality!

But you know the fragile touch we as a supplier of materials – **and particularly you as the extruder** – must control to enable you to guarantee it for years.

The **ADVANCE Advastab** 3-product combination... **BC-100, Z-6 WW** and **CH-300**... going into the best known names of garden hose today, represents a streamlined concept of stabilizer balance. The tailored-to-the-job combination of these 3 stabilizers greatly simplifies the required fragile touch.

This 3-product combination cannot be equaled... for early color – maintenance of early color – control of color drift – clarity – $H_2S$ stain resistance – long term heat and light stability. In any extrusion – even with cross-head dies – you'll enjoy longer runs between shutdowns.

We would like to tell you more... and you'll be glad we did... because most companies who have switched to the **BC-100** system have dropped their stabilizer cost over 10%. Samples, data and our technical development staff are at your disposal. Call or write.

These and many others, including a full line of **organo-tin stabilizers** such as **T-52N, T-17M** and **T-72,** are available from **ADVANCE SOLVENTS & CHEMICAL,** 500-1 Jersey Avenue, New Brunswick, New Jersey... and from...

Advance International Ltd.,
245 Fifth Avenue, New York 16, New York

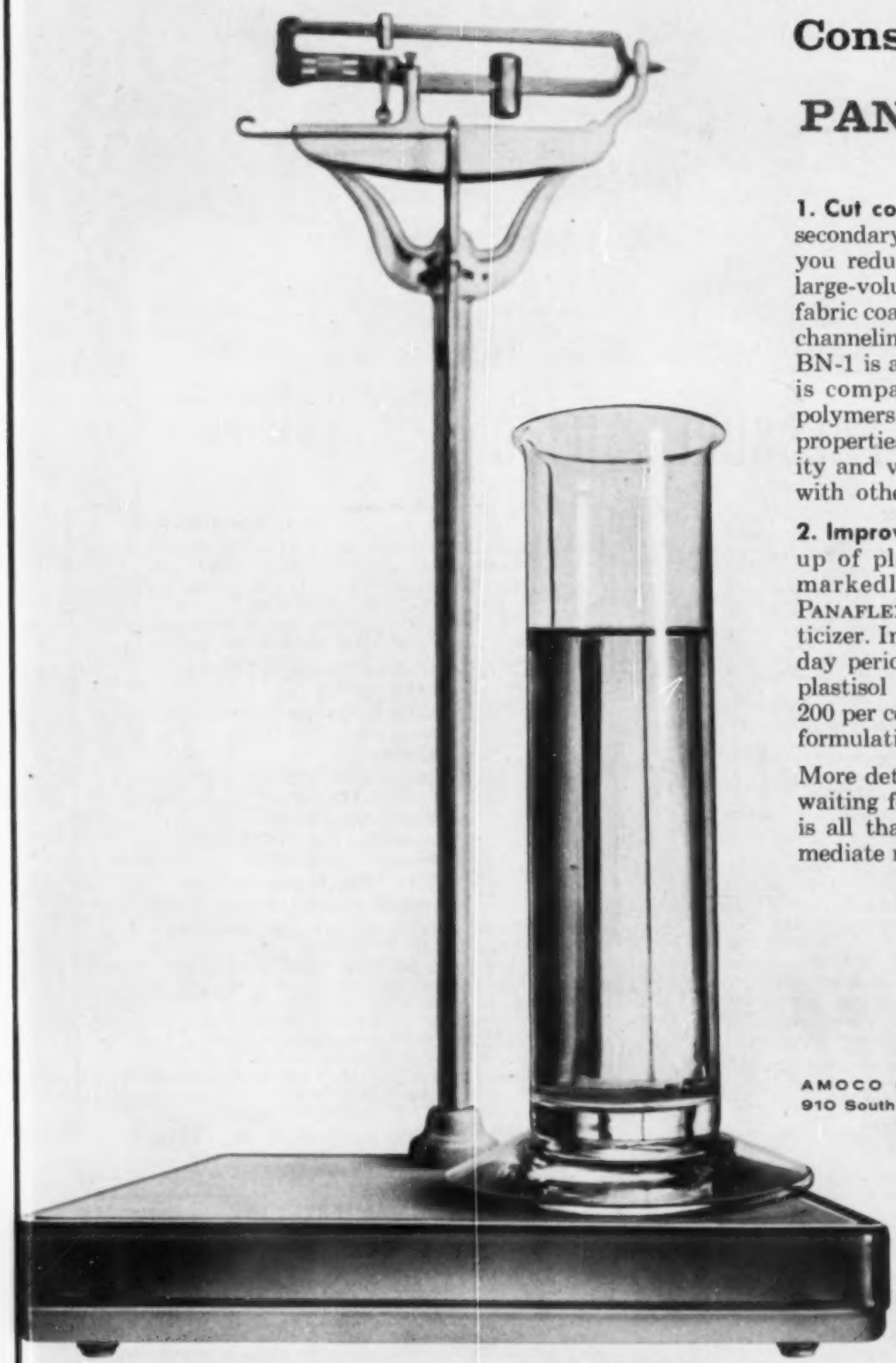
Advance Solvents & Chemical
Corp. of Canada, Ltd.,
Montreal and Toronto

*and from our Manufacturing Affiliate...*
**Deutsche Advance Produktion G M B H**
Marienberg Bei Bensheim
(Bergstrasse)
Western Germany

A&W DIVISION OF CARLISLE CHEMICAL WORKS, INC.

**ADVANCE**

# Anybody looking for a way to reduce plastisol costs? Consider PANAFLEX BN-1



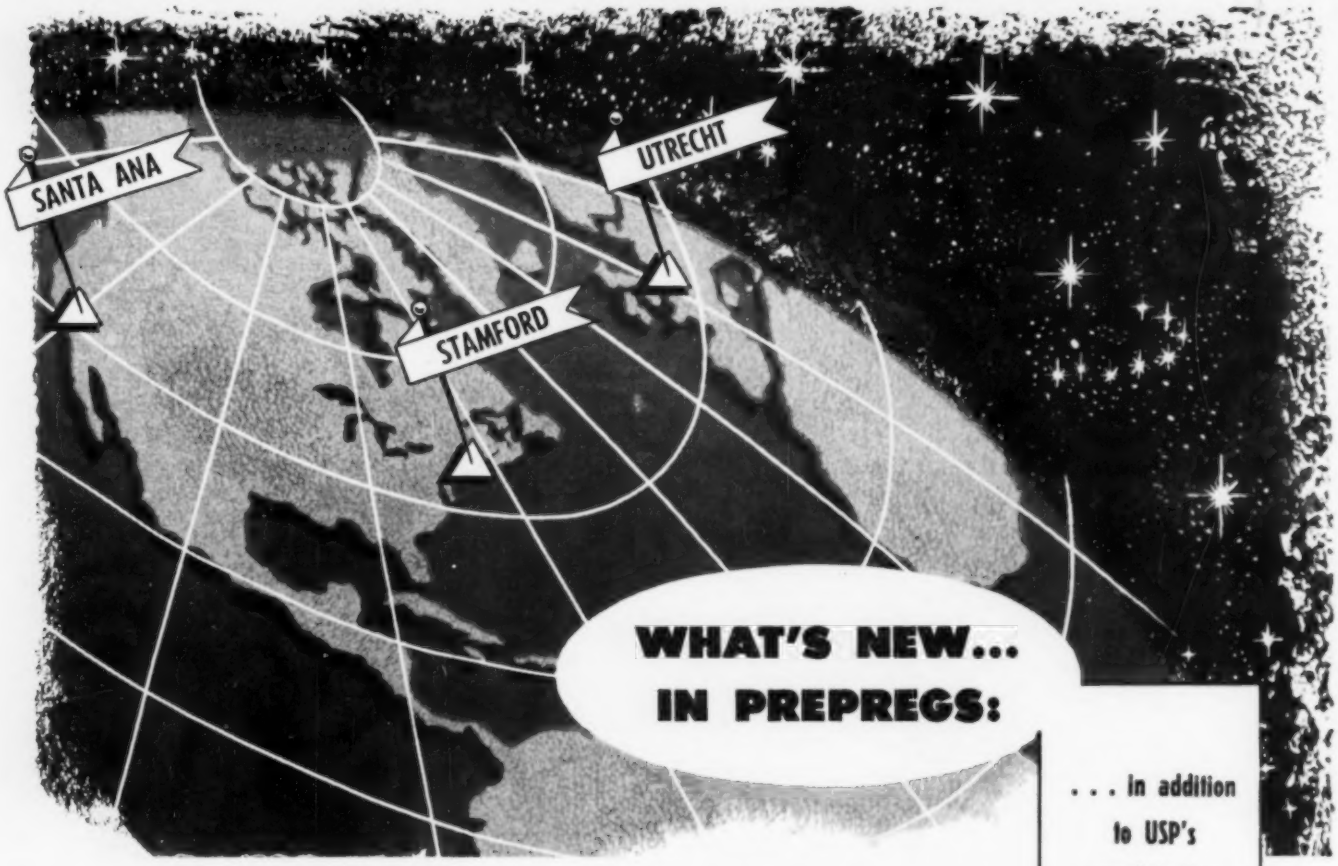
**1. Cut costs.** PANAFLEX BN-1 is a secondary plasticizer that can help you reduce costs, especially in such large-volume, low-cost applications as fabric coatings, jacketing, cushioning, channeling or gasketing. PANAFLEX BN-1 is a hydrocarbon plasticizer. It is compatible with vinyl chloride polymers and copolymers. Electrical properties are excellent. Color stability and volatility compare favorably with other hydrocarbon plasticizers.

**2. Improve stability.** Viscosity build-up of plastisols during storage is markedly reduced by the use of PANAFLEX BN-1 as a secondary plasticizer. In one stability test over a 50-day period at 115° F., viscosity of a plastisol with PANAFLEX BN-1 was 200 per cent less than a straight DOP formulation.

More details on PANAFLEX BN-1 are waiting for you. A letter, wire or call is all that's needed to bring an immediate reply.

AMOCO CHEMICALS

AMOCO CHEMICALS CORPORATION
910 South Michigan Ave., Chicago 80, Illinois




# TACKY LOW-PRESSURE SILICONE

Until very recently, all silicone prepregs were dry and stiff, making it extremely difficult to lay-up and mold complex shapes, particularly at low pressure.
Formerly, silicone prepregs could be provided with some degree of drape and tack, artificially induced by leaving a relatively high percentage of impregnating solvent in the fabric. However, this led to short shelf life and molding problems.
Now available to industry is a silicone-impregnated fabric with tack, drape and low residual volatile content — Tacky Low-pressure Silicone S-890 — pioneered by U. S. Polymeric. This splendid new silicone Poly-Preg offers these advantages.

*. . . excellent drape and tack for laying-up complex shapes*
*. . . ability to mold easily at vacuum-bag pressure*
*. . . low residual volatile content, minimizing curing troubles*
*. . . good shelf life*

Tacky Low-pressure Silicone S-890 normally is applied to heat-cleaned glass cloth with a neutral pH finish, but it also can be applied to asbestos and other high-temperature reinforcements. It has many applications in the aircraft and missile field, specifically for items such as hi-temperature radomes, hot-air ducts and drag-chute containers. In fact, Tacky Low-pressure Silicone S-890 may be used in a variety of aircraft or missile applications where a combination of high temperature and electrical properties are necessary.

Expanded production facilities have greatly increased the flow of U. S. Polymeric POLY-PREG from plants on either coast, to give you the kind of service and delivery you demand.
U. S. Polymeric's extensive line of preimpregnated paper, glass cloth and mat now include:

- . . . Hi-Heat Phenolic POLY-PREG (with 91-LD
- . . Ultra-High-Temperature Resin POLY-PREG (with 37-9X)
- . . . Polyester POLY-PREG
- . . . Silicone POLY-PREG
- . . . Epoxy POLY-PREG
- . . . Melamine POLY-PREG
- . . . Phenolic POLY-PREG
- . . . POLY-PREG Two-In-One (with Silicone Modified Rubber)

Through continual research and development, Polymeric's staff of engineers are creating new products and processes, such as POLY-PREG T.I.O., to meet the ever-increasing demands of industry and defense.

*For specific recommendations concerning materials and material specifications, engineering assistance on any individual application is available upon request. Merely write: Engineering Department, U. S. Polymeric Chemicals, Inc., Stamford, Conn.*

POLYMERIC U.S.

**U. S. POLYMERIC CHEMICALS, INC.**
STAMFORD, CONNECTICUT • SANTA ANA, CALIFORNIA
**POLYMERIC N. V.**
UTRECHT THE NETHERLANDS

## For Outstanding Heat, Light and Water Resistance in Your Vinyl Products

## Standardize on PEROXIDOL 780

## RCI's New Polymeric Plasticizer

PEROXIDOL 780 is an epoxy-type plasticizer which can be employed in vinyl processing either to boost heat stability or to reduce stabilizer content for equivalent stability. Economically priced, PEROXIDOL 780 is light in color, easy to process and does not volatilize in production. Higher processing speeds are assured by its unique combination of stabilizer action, good wetting properties and low volatility, and both the light stability and color retention of compounds incorporating 780 are excellent.

PEROXIDOL 780 can be used in calendering, extruding and molding operations . . . in plastisols, organisols, solution coatings and dispersions. Rainwear, garden hose, wading pools and lawn furniture cushions plasticized with 780 are characterized by their ability to withstand exposure to all kinds of weather . . . and by their strong resistance to water, soap and detergents, and oil.

Write RCI's Chemical Division today for your copy of their PEROXIDOL Bulletin, which contains specifications and complete information on this versatile plasticizing agent.

# REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol
Hydrochloric Acid • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Ortho-Phenylphenol • Sodium Sulfite
Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

**REICHHOLD CHEMICALS, INC.,**
**RCI BUILDING, WHITE PLAINS, N.Y.**

*Creative Chemistry . . . Your Partner in Progress*

# For Vinyl Electrical Insulation that Resists High Temperature at High Humidity...

# PARAPLEX G-54

Formulators of vinyl compounds should be particularly interested in PARAPLEX G-54—vinyl compounds containing PARAPLEX G-54 are especially well suited for high-temperature insulation used under "wet" conditions. This new Rohm & Haas plasticizer was specifically designed to provide freedom from exudation (spew) on exposure to high humidity at elevated temperatures.

Vinyl compounds plasticized with PARAPLEX G-54 also show better volume resistivity . . . outstanding retention of elongation after high-temperature exposure . . . superior plasticizing efficiency . . . high dry dielectric strength and very good retention of dielectric strength after immersion in water . . . excellent resistance to copper corrosion . . . compatibility with stabilizing plasticizers . . . outstanding resilience.

For more detailed information about all Rohm & Haas plasticizers and their applications, send for *What You Should Know About* PARAPLEX *and* MONOPLEX *Plasticizers.*

PARAPLEX *and* MONOPLEX *are trade-marks, Reg. U.S. Pat. Off. and in principal foreign countries.*

*Chemicals for Industry*

**ROHM & HAAS COMPANY**

**THE RESINOUS PRODUCTS DIVISION**

**Washington Square, Philadelphia 5, Pa.**

*Representatives in principal foreign countries*

# NEWS in BRIEF

Isocyanate consumption can be expected to reach 12-million pounds this year, and will continue upward into the 40-50 million pound range by 1960, according to Joseph Marzak, market research manager for Allied Chemical's National Aniline division. He named coatings, potting compounds, adhesive, textile treatment, and injection and compression molding as the best fields for future growth, together with flexible foams and wire coatings.

Custom molders have been the point of contact between the materials supplier's pilot plant, the machinery manufacturer's new press, and the needs of the customers for plastic parts, acccording to John Bachner, president of Chicago Molded Products Corp. (see Guest Editorial, pg. 653). Now, however, more and more molders have become "custom molders" in name only.

Business developments in the plastics industry saw the formation of a new consulting and manufacturing firm, Adams Fibreglass Co., in Wilmington, Md. Appleton Machine Co. purchased Doven Machine & Engineering and will move it to the new owner's Appleton, Wisc., plant site. Dow Chemical purchased the common stock of Extruders, Inc., supplier of polyethylene film to West Coast markets, that will continue to operate as a Dow subsidiary under the same management. Midland-Ross Corp. purchased Hartig Engine & Machine Co., which will continue as a division. A new firm, Plastitrol, was formed as a Southern California distributor of plastic piping. The entire outstanding capital stock of Halex Corp., Detroit, Mich., was purchased by Polymer Corp., and will be expanded as a division of the new owner.

Company expansions in plastics continued in the news. The Freedlander Research & Development Labs were opened by Dayton Rubber Co. for basic research and product development on urethane materials, quality control work, organic analysis, and prototype fabrication. DuPont is building a Teflon 100-D plant at Parkersburg, W. Va. An expanded plant is the new site for Continental Plastics in Oklahoma City, Okla. Celanese opened a PVC emulsion facility adjoining its Belvidere, N. J., plant. More than $500,000 is being spent by Ferro Corp. to expand its Brazilian subsidiary and its Ferro Fiber Glass Div. in Nashville, Tenn. Narmco, Inc., opened its new research and development center at San Diego, Calif. Owens-Illinois Glass Co. is undertaking commercial production of high-density polyethylene containers. A production facility for hydrocarbon resins and aromatic solvents has been placed on stream by Pennsylvania Industrial Chemical Corp. at West Elizabeth, Pa. Some 11,000 square feet of added manufacturing space were acquired by Reed Plastics Corp., Worcester, Mass. Sarco Mfg. Corp. is adding a new wing to its Bethlehem plant, which also serves the allied firm, Sarco Co., Inc.

New Materials worthy of attention (see pages 669-671): high-density polyethylene; series of chemical absorbents (molecular sieves); copper-clad epoxy-glass laminates; one-component epoxide casting resins and impregnant; two PVC plasticizers; series of epoxy casting, encapsulating, and embedding compounds; primary PVC plasticizer; epoxy flexibilizer-hardener catalyst; high-melt viscosity nylon extrusion compound; two-component, internal-setting, low-temperature adhesive for rigid insulations; and lacquer for coating glass-polyester panels.

New Equipment of special interest (see pages 672-674): self-contained, cobalt-60-irradiation unit; urethane foam mixer for intermittent operations; adjustable plastics weigh-feeder; line of axial-flow, extension-shaft fans for industrial exhausting uses; pneumatic feed attachment to return plastics from granulator to injection machines; manually-operated, bench-model injection molding machine; and series of induction-heated plastics extruders.

Plastics Applications to be noted (see pages 675-677): butyrate dispenser for tablets; boat and dock bumpers of extruded vinyl; broom of nylon monofilaments for street-sweeping use; oriented polystyrene packaging film; corrosion-resistant faucets with Teflon seals; line of small-diameter, paper-based phenolic tubing; molded polyethylene swim fins; plastics scintillators for detecting nuclear radiations; all-nylon clamps for cables; and a new series of disposable polystyrene cups.

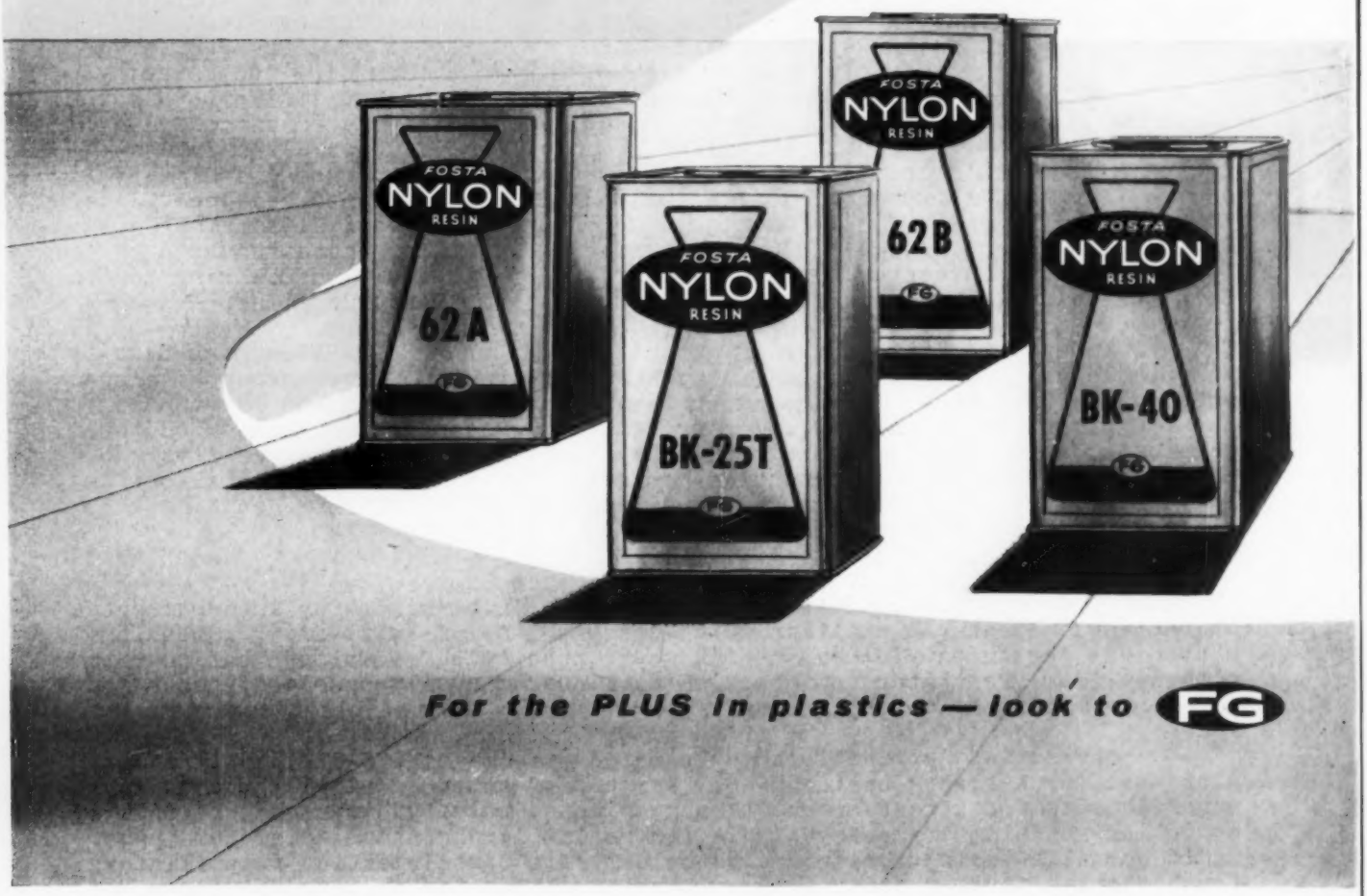
# FOSTER GRANT *Announces:*

# FOSTA®

The growing preference for nylon products in both consumer and industrial applications has created important, new markets for the plastics industry. To help the molder and extruder meet this increasing demand, Foster Grant offers a complete range of nylon materials — five grades, custom compounded for the specific requirements of the end product, and for maximum efficiency in production.

As always, the industry may look to Foster Grant for *production proved*, quality materials and for production assistance based on 40 years' experience as a pioneer in the plastics industry.

To learn more about Fosta Nylon and its potential for you, write for our new, informative brochure, "Fosta Nylon — Its Role in Your Operations."

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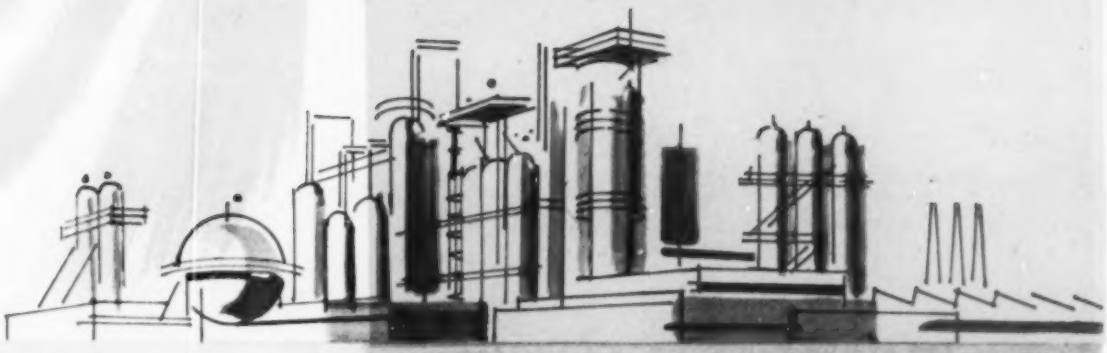

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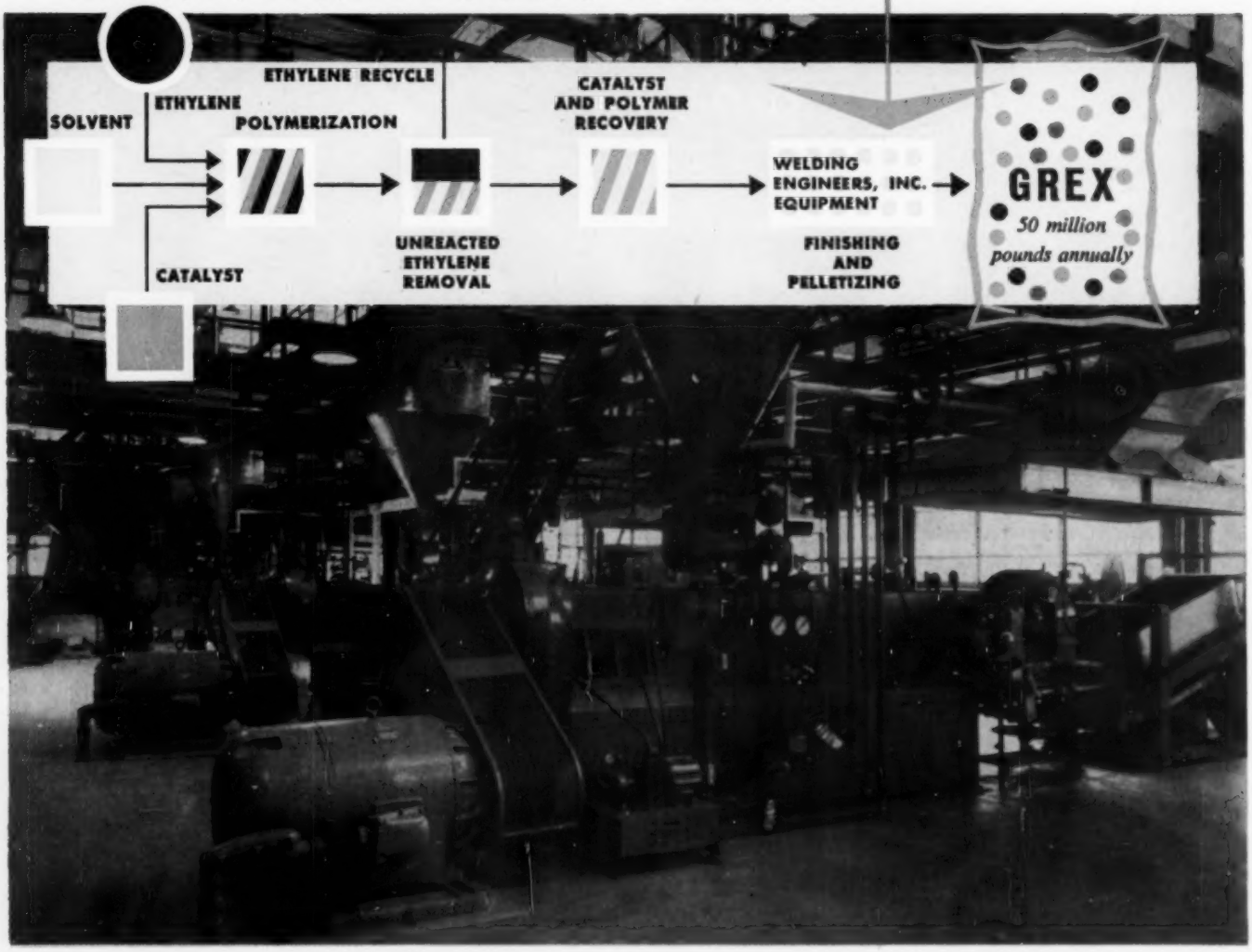


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PLASTICS TECHNOLOGY

# Physical Properties of Prepreg Laminates

**The effects of such variables as curing time and temperature, laminating pressure, and resin content are investigated.**

GRANT BROWN, *Vice Pres. & Tech. Director*
*Cordo Chemical Corp., Mobile, Ala.*

Grant Brown was born in Syracuse, N. Y., in 1912, and was brought up in Prescott, Ont., Canada, where he received his primary school education. This was followed by further education at Cornell University and the University of Alabama, receiving a B.S. in Chemical Engineering from the latter in 1937. From 1937-1943, he held various positions with General Chemical Co.; from 1943-1944, was division superintendent for Cordo Chemical Corp.; from 1944-1946, was technical director for Plastic Film Corp.; and was a consulting engineer from 1946-1950. He was technical director of Mobile Plastics Div., Carlisle Corp., from 1950-1956. With the purchase of the Mobile Div. by Cordo Chemical Corp. in 1956, he was appointed to his present position as Vice President and Technical Director of Cordo Chemical Corp. Since 1596, he has also served as a consulting engineer for designing and building plants for coating and impregnating of fabrics.

Mr. Brown is a member of SPE, SPI, the Instrument Society of America, the Chamber of Commerce, the U. S. Naval Institute, and the U. S. Power Squadron. Mr. & Mrs. Brown and their son make their home in Mobile, Ala.

MANY of the variables that affect the final physical properties of a reinforced plastic structure made from preimpregnated fiberglass cloth are controllable. This paper reports the results of an investigation of some of these controllable variables, such as curing cycle, resin, pressure, and resin content. It shows that not all physical properties are affected in the same manner by the same variable; thus, desirable specific properties may be improved greatly by proper selection of variables.

The controllable variables in reinforced plastic structures made from preimpregnated fiberglass cloth fall into two groups. The first group is controlled by the prepreg manufacturer. In this group, are resin, reinforcement, finish, and resin content. The second group is controlled by the molder, and includes temperature, time, pressure, and method of molding. No attempt has been made to date to evaluate and compare similar laminates made by press, vacuum bag and autoclave methods.

During the routine determination of cure cycles, some interesting results indicated that further investigation of laminate properties might prove valuable. Feeling that the chemical engineering department at the University of Alabama might be interested in such a project, it was outlined and submitted to this depart-

ment. The project was accepted and assigned to a graduate student for use as his thesis leading to a Masters Degree. Table 1 and Figure 1 are the result of this work. A comparison of quality control tests, particularly those on prepreg with different resin contents, indicated the desirability of obtaining additional data. The tests, therefore, were expanded, and the additional data obtained showed the need for still further expansion of the tests.

At about this time, the entire prepreg industry was canvassed and asked to contribute any data that they had available. This they did, and some of the results are included in this paper. When the cure cycles were well under-way, the effect of varying the pressure, as well as the time and temperature, was investigated. The effect of pressure was about as expected, although better results were obtained at lower pressures than normally are considered feasible with prepreg. The

**Table 1. Flexural Strengths of Glass-Reinforced Prepreg Laminates.**

| Resin | Glass Reinforcement | Curing Time, Min. | Laminate Flexural Strength, Psi., After Curing at 200° F. | 225° F. | 250° F. | 275° F. | 280° F. | 300° F. | 325° F. | 350° F. |
|---|---|---|---|---|---|---|---|---|---|---|
| Polyester* | 181 Cloth | 2 | — | — | — | 54,100 | — | 52,800 | — | — |
| | | 3 | — | — | 50,000 | 56,700 | — | 56,000 | — | — |
| | | 5 | — | 55,200 | 56,200 | 55,400 | — | 56,600 | — | — |
| | | 15 | — | 59,600 | 53,800 | 56,000 | — | 54,000 | — | — |
| Polyester** | — | 1 | — | — | 19,300 | 41,900 | — | 43,900 | 35,900 | — |
| | | 2 | — | — | 33,100 | 46,700 | — | 45,700 | 35,900 | — |
| | | 3 | — | 20,900 | 46,200 | 46,300 | — | 43,700 | 36,700 | — |
| | | 5 | — | 24,300 | 46,600 | 49,600 | — | 44,700 | 35,600 | — |
| | | 15 | 18,800 | 49,900 | 49,300 | 50,100 | — | 46,100 | 33,600 | — |
| | | 20 | 22,500 | 55,400 | 55,100 | — | — | — | — | — |
| | | 30 | 29,900 | 48,100 | — | — | — | — | — | — |
| Diallyl phthalate*** | 1044 Cloth | 3 | — | — | — | — | 16,900 | 24,400 | 20,900 | — |
| | | 5 | — | — | 20,000 | — | 28,800 | 25,000 | 23,700 | — |
| | | 7 | — | — | — | — | 28,600 | 25,600 | 25,600 | — |
| | | 10 | — | — | 27,600 | — | 30,200 | 25,500 | 27,500 | — |
| | | 12 | — | — | 29,300 | — | 29,600 | 27,200 | 25,000 | — |
| | | 15 | — | — | 28,300 | — | 29,600 | 28,200 | 24,500 | — |
| | | 20 | — | — | 29,900 | — | 29,700 | 27,800 | 21,500 | — |
| | | 30 | — | — | 31,900 | — | 30,500 | 26,300 | 22,700 | — |
| | | 45 | — | — | 31,700 | — | 29,800 | 30,200 | 25,000 | — |
| | | 60 | — | — | 31,600 | — | 28,000 | 24,400 | 25,500 | — |
| Diallyl phthalate‡ | 181 Cloth | 2 | — | — | — | — | — | — | 54,300 | 47,200 |
| | | 3 | — | — | — | — | — | 36,500 | 54,000 | 51,600 |
| | | 5 | — | — | — | — | — | 48,500 | 55,200 | 48,800 |
| | | 10 | — | — | — | 49,800 | — | 61,700 | 52,600 | — |
| | | 15 | — | — | — | 52,000 | — | 60,500 | — | — |
| | | 30 | — | — | — | 63,000 | — | 53,800 | — | — |
| | | 60 | — | — | — | 57,400 | — | 53,500 | — | — |
| Epoxy‡‡ | 181 Cloth | 10 | — | — | — | — | — | — | — | 63,600 |
| | | 15 | — | — | — | — | — | — | 48,500 | 70,300 |
| | | 20 | — | — | — | — | — | — | 51,300 | 70,700 |
| | | 30 | — | — | — | — | — | — | 72,000 | 69,200 |
| | | 45 | — | — | — | — | — | 70,300 | 73,800 | 72,400 |
| | | 60 | — | — | — | — | — | 72,300 | 72,700 | 70,800 |
| Phenolic‡‡‡ | 181 Cloth | 3 | — | — | — | — | — | 38,900 | 57,100 | — |
| | | 5 | — | — | — | 6,700 | — | 48,800 | 60,100 | — |
| | | 10 | — | — | — | 55,700 | — | 63,500 | 61,200 | — |
| | | 15 | — | — | — | 58,300 | — | 65,600 | 69,400 | — |
| | | 30 | — | — | — | 62,800 | — | 66,400 | 69,000 | — |
| | | 60 | — | — | — | 59,500 | — | 63,300 | — | — |
| Phenolic**** | — | 2 | — | — | — | — | — | 13,800 | 42,900 | 51,500 |
| | | 3 | — | — | — | 2,280 | — | 34,800 | 45,600 | 50,700 |
| | | 5 | — | — | — | 11,100 | — | 48,700 | 43,600 | 55,900 |
| | | 10 | — | — | — | 48,000 | — | 46,100 | 53,900 | 48,200 |
| | | 15 | — | — | — | 40,000 | — | 42,500 | 53,600 | 51,200 |
| | | 30 | — | — | — | 39,900 | — | 47,800 | 43,700 | 45,600 |
| | | 60 | — | — | — | 46,000 | — | 48,500 | 51,700 | 52,200 |

*Stypol 25D-Shell 85:50 combination; benzoyl peroxide catalyst.
**Cordopreg H-165 FR resin.
***With benzoyl peroxide catalyst.
‡Mobaloy 81-D resin with special catalyst system.
‡‡Epon 1001 resin; dicyandiamide curing agent.
‡‡‡Plyophen 5013 resin.
****Mobaloy 81-AH resin.

next variable investigated was the effect of resin content; this proved so startling that this phase was expanded vastly, and data still is being accumulated as rapidly as possible.

The most recently investigated variable was that of cloth finish. Most of the commercially-available finishes were checked using the same resin. These all were processed in one impregnating run so as to equalize all other variables, insofar as possible.

## Cure Time, Temperature

Table 1 shows the data obtained by varying the time and temperature during curing. All the laminates were ⅛-inch thick and made at a pressure of 15 psi. The temperatures reported were taken from a thermocouple buried in the center of the laminate. These thermocouples were made from very fine wire so as not to distort the laminate, and the temperatures were recorded on a strip-chart recorder. The time reported is the total time, in minutes, in the press. The thermocouples indicated maximum temperatures about two minutes after being put in the press.

It is interesting to note that some materials, namely those that have relatively poor physical properties at elevated temperatures, show some tendency to overcure. The lower physical properties shown in some cases at the highest temperatures probably are due to too rapid gelation of the resin that does not permit sufficient flow to take place within the laminate. A very heavy open-weave cloth was included for purposes of comparison. Two different catalyst systems also were evaluated on the diallyl phthalate resin.

It should be noted at this point that some of the physical properties appear to be on the low side. This is accounted for by the fact that some of the early work was done using cross-plied laminates. Some additional work has been done on curing certain polyester laminates at temperatures as low as 160° F. It has been found that a satisfactory cure at this temperature may be obtained in six hours. This certainly is of little interest for normal production, but does show that, under certain conditions, an acrylic window required in a laminate can be molded-in. Such an application is being made today.

The optimum cure time at each temperature was taken from these tables and plotted as curves given in Figures 1 and 2.

## Laminating Pressure

Figure 3 shows the effect of laminating pressure on flexural strength properties when the laminates were made at pressures below those encountered in normal vacuum-bag operations. This is about as expected, although fair properties were obtained at pressures well below those that most prepreg manufacturers would recommend. The decrease in flexural strength at the 50-psi. level is attributed to the extremely high flow at this pressure, with consequent washing and distortion of the fabric. This test was made on a relatively small laminate, and this distortion probably would not take place more than three or four inches from the edge.

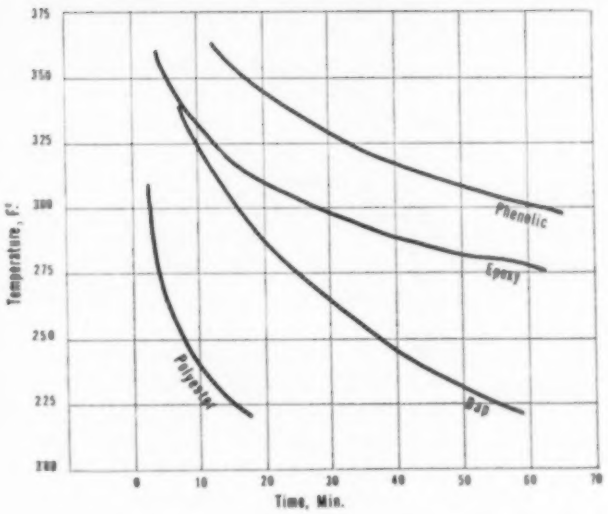


Fig. 1. Optimum cure cycles for Stypol polyester, diallyl phthalate, Epon epoxy, and Plyophen phenolic resin-glass prepreg laminates.

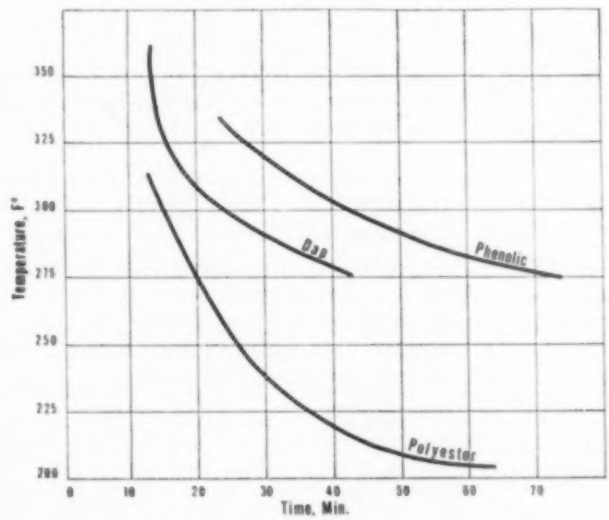


Fig. 2. Optimum cure cycles for Cordopreg polyester, Moboloy diallyl phthalate, and Moboloy phenolic resin-glass prepreg laminates.

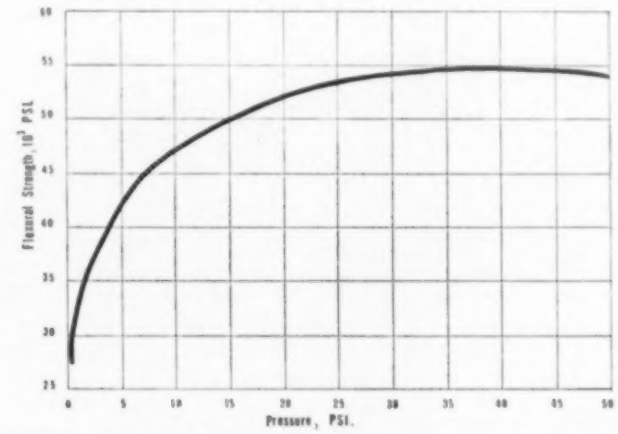


Fig. 3. Effect of laminating pressure on flexural strength of Cordopreg-H165 polyester resin-glass prepreg laminates.

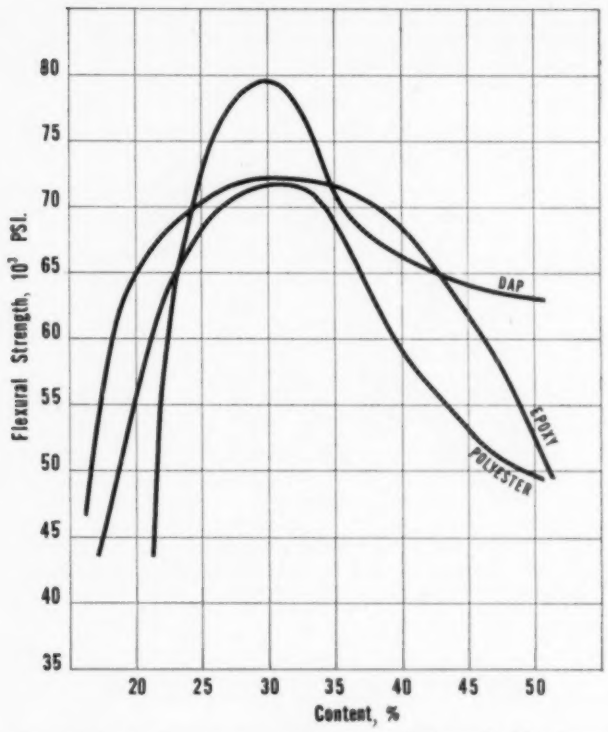


Fig. 4. Effect of resin content on flexural strength of prepreg glass laminates made of Moboloy diallyl phthalate, Cordopreg polyester, and Moboloy epoxy resins.

The most interesting curves are those in Figures 4-6 that show the flexural strength, flexural modulus, and edgewise compression of DAP. This was the most thoroughly investigated of all the materials. It was the first one tested, and it was rechecked three times on three different runs of prepreg before the figures finally were accepted. The extremely high results found at the peak of the curve were checked on probably 30 different laminates from five or six different runs, using different cloth and different batches of resin. The base 181-cloth itself was checked to be sure that it was not of exceptionally high quality.

Additional panels at this resin content were made in a vacuum bag, and the physical properties of these panels fell right in line with those made in the press. Tensile strength values also were checked at this extremely low resin content, and were very high as would be expected. It is interesting to note that on reaching approximately 25% resin content the panels reached a minimum thickness; at this resin content, it took 16 layers of 181-cloth to produce a panel approximately ⅛-inch thick. A theoretical calculation of the amount of resin necessary to fill the voids in the cloth at the thickness obtained is only very slightly below the actual amount of resin used.

## Resin Content

Previously published data on the effect of resin content did not indicate that such low resin contents were feasible. One possible explanation is that it is not possible to get perfectly uniform resin distribution or saturation at these low resin contents by the wet lay-up method on which such figures were based. The cost of running and evaluating so many different resin contents with prepreg would be prohibitive normally; yet it is only with prepreg that such uniform low resin-content laminates can be made. The author was very fortunate in having a pilot impregnating machine available to him. This machine is a continuous impregnator that in every way is equal or superior to the best production equipment in operation today. It has fully automatic

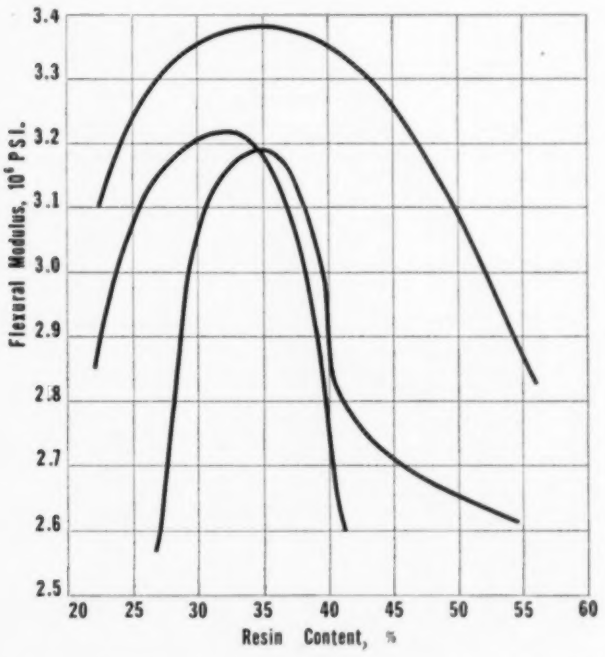


Fig. 5. Effect of resin content on flexural modulus of prepreg glass laminates made from Moboloy diallyl phthalate, Cordopreg polyester, and Moboloy epoxy resins.

Figure 6

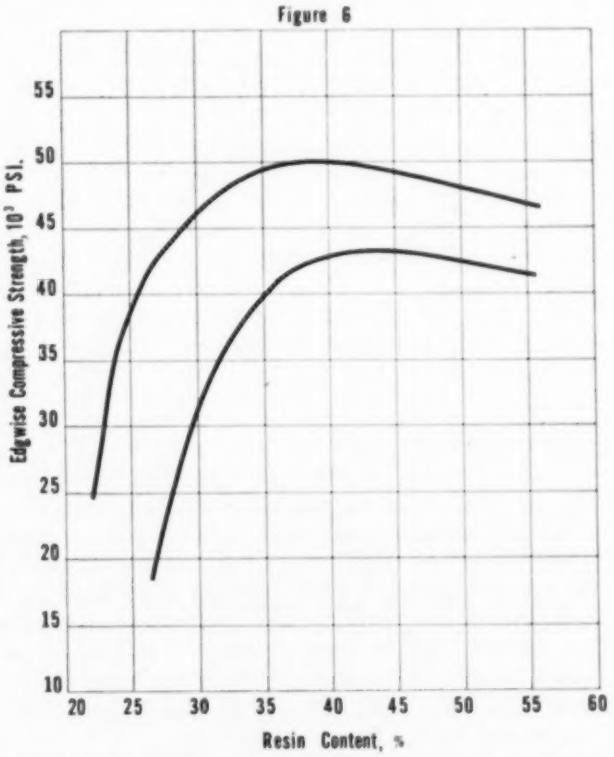


Fig. 6. Effect of resin content on edgewise compressive strengths of prepreg glass laminates made of Moboloy diallyl phthalate and epoxy resins.

flow is capable of being changed to give optimum results under practically any impregnating condition. It will impregnate a web up to 12 inches wide, and will handle materials ranging in weight from tissue paper to heavy mat.

Figures 4 and 5 show the curves for flexural strength and flexural modulus for a typical polyester, Cordopreg-H165. It is interesting to note that the strength and modulus do not show peaks at the same resin content, and that neither of the peaks for this material correspond too closely with the peaks for DAP. Figures 4-6 show the flexural strength, flexural modulus, and edgewise compression curves for an epoxy, Moboloy-81. Here, again, we see even more marked differences in the peaks of the curves as compared with DAP and polyester.

Figure 7 shows the flexural strength at room and elevated temperatures of cloths having different finishes. As stated before, all cloths were impregnated in a single run. The resin content was fairly high so as to avoid the steep part of the flexural strength curve and, thereby, minimize variations due to slight differences in resin contact. Actually the resin contents came very close despite differences in base cloth weights. This chart clearly indicates the necessity of picking the finish for the job. For example, the 301-finish is very good at room temperature, but falls down badly at 350° F., while the A-1100 finish is best at 350° F. but very poor at room temperature and at 450° F.

## Conclusions

It is not the intent of this paper to suggest that the engineer and designer attempt to investigate or even to specify the variables covered by this report. If anything, it is intended to discourage such specifications on the part of the customers. For example, engineers very seldom, if ever, specify the exact constituents of an aluminum alloy, or the exact heat-treating or cold-working cycle for that alloy. Instead, they go to a recognized supplier with their requirements, and the supplier recommends an alloy and, if necessary, the fabricating procedure needed to do the job.

Similarly, an engineer can and should go to a recognized manufacturer of prepreg to get the information and materials that he needs to do his job. These manufacturers have both the know-how and the elaborate equipment necessary to produce a uniform, high-quality, pre-impregnated material. This puts the burden on these manufacturers but, at the same time, insures that the material they supply will do the job and that no one ends up with thousands of yards of prepreg that will not perform properly. Such a situation does nothing but harm to both the reinforced plastic industry and the consumer who erroneously specified his needs.

This paper does suggest that the engineer become familiar with the material possibilities available to him by the control of variables, and that he go to the manufacturer even though his requirements may seem unreasonable. Perhaps by sacrificing some non-vital property, the desired requirements may be met.

Finally it is hoped that this paper may aid the engineer and designer to a better understanding of the possibilities of prepreg. This study is to be continued and expanded in the future, and it is hoped that others can and will contribute to the work.


## Acknowledgment

The author wishes to acknowledge the help, information, and encouragement given him by practically all prepreg manufacturers.


—The End

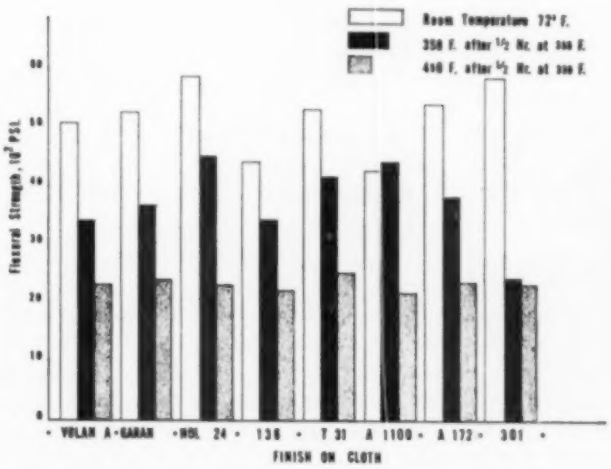
Room Temperature 72° F.
350 F. after ½ Hr. at 350 F.
450 F. after ½ Hr. at 350 F.
Flexural Strength, 10³ PSI
0
10
20
30
40
50
60
• VOLAN A • GARAN • 901 24 • 136 • T 31 A 1100 • A 172 • 301 •
FINISH ON CLOTH

Fig. 7. Fleuxral strengths at various temperatures of prepreg laminates made of glass cloths with different finishes.

# Plastic–Aluminum Hi-Fi Components

Plastic and aluminum extrusions have invaded a field heretofore monopolized by stamped sheet metal. Featuring functional high styling at no loss in fidelity, the extrusions make up the new Bogen tuner and amplifier cabinets.

The dial-scales are extruded of translucent white Plexiglas, Rohm & Haas' acrylic resin, by Anchor Plastics. Numerals and logging scale is silk-screened onto the surface. Lower parts of the cabinet front panels are extruded from Alcoa anodized grey aluminum.

Bogen RB 115 AM-FM Receiver is constructed of interlocking acrylic and aluminum extrusions.

R. E. MOLLMAN, *Prod. Mgr.*
*Plastic Products Corp.*
*Cleveland, Ohio*

# Reinforced Plastics Preforming Without Discoloration

**A case study of discoloration problems and their successful prevention or cure.**

THE regular daily production of preforms suitable for molding white parts still is by no means a cut-and-dried science. Each job has its own problems and many times one will have to be just plain lucky with plant location, wind direction, dust, and smog conditions. There are, however, a number of important steps that can be taken (in some cases, must be taken) in order to successfully produce white preforms.

These factors will not entirely eliminate discoloration in preforming or molding but, if followed up, can turn a headache job into a profitable operation. Although our fiber glass molding industry has much in common with other plastic molders when it comes to the production of light-colored parts, we have a special problem in molding fiber glass because of its ability to collect and filter out dust and dirt from any source. This characteristic makes the filter people very happy, but causes us no end of trouble.

The preform binder generally is blamed for any and all fiber discoloration. In many cases, it is not the binder at all, but other factors that are to blame. Often, however, our preform binders have been just borderline at best. New types of polyester binders, and the acrylic binders now available, have been a big step forward in enabling the molder to make a success with light-colored moldings.

In this paper, we will not discuss the effects that various binders have on physical properties, weather resistance, etc. Such a discussion would involve a paper in itself and often, when color is a prime objective, other factors weigh less heavily on the selection of a binder.

## Resin Binder

To date, we have found our greatest success with the acrylic binder. A white preform can be obtained with ease, even when the cure time is not regulated closely. This type of binder may be cured over a wide range of temperatures, and shows little discoloration when over-cured.

Ease of handling is a major asset of the acrylic binder. The binder comes emulsified at 50% solids and,

for use, is merely diluted with water to the desired solids content. There is no mess or fuss with mixing or catalyzing, and any spillage can be mopped or cleaned up easily when dry. The emulsion dries to a white powder that is very helpful in keeping the preforming and spraying equipment in good working order.

In chamber-type preform machines, the use of a polyester binder may cause the chamber walls of the machine to become sticky or tacky with partially-cured binder. This coating tends to collect dirt and glass that may later find its way to the preform screen. The dust left by the acrylic binder causes no problem in this respect and is one of the big advantages, other than color, that benefits the user.

Most of the older polyester binders had an off-white color. Cure time and oven temperature had to be controlled very closely to obtain even a light-colored preform. The color problem has been largely overcome with the newer polyester binders now available that already are emulsified at about 40-60% solids. The big problem remaining with polyester binders is the tacky film left by the over-spray in the preform machine and fans, etc. In some preform operations, such as on the open-type preform machine, this coating may not be a serious problem, but the polyesters, in general, complicate the job of keeping the preform equipment clean. This is a must under most conditions and, especially, when molding light colors.

## Preform Oven

The preform oven is an extremely important part of the manufacturing operations for white preforms. The proper oven should be capable of drawing a high volume of air through the preform itself. To do this, the oven fan must be of sufficient capacity and driven with enough power to develop several inches of water static pressure across the preform in order to draw air through the glass. With a high volume of heated air, it is possible to cure preforms quickly without resorting to abnormally high oven temperatures. Too-high temperatures will cause fiber discoloration, regardless of the type of binder used.

The most common type of preform oven is direct gas-fired, and there appears to be no problem due to products of combustion discoloring the preform if the burner is in proper adjustment. Electric ovens, of course, are quite clean, but generally have higher initial and operating costs. Oil-fired ovens can be used, but should be indirectly fired in order to isolate the preforms from the products of combustion.

While on basic oven design, it is important to incorporate a filter screen (a common 1/16-inch square mesh window screen being very satisfactory) somewhere in the fan ducting to catch those random fibers that always fall off the preform and find their way into the air stream. Such fibers usually are discolored due to picking up dirt from the oven itself (off sheet metal, etc.). Since they remain in the oven for some length of time, the binder on these fibers becomes over-cured and brown in color. A filter screen generally can be added to an existing oven if it was not incorporated in the original design. An oven that can be cleaned easily to remove these loose fibers is an important factor to look for when purchasing new equipment.

Fig. 1. Preforms being placed on automatic conveyorized oven to insure proper curing time cycle.

## Curing Timer

In order to control the color of the preform, it is important to time the curing cycle. Such timing should not be left to the operator and his wristwatch, but should be controlled by a timer installed on the oven itself. Timing may be accomplished by several methods. A manual system can be set up very easily. We set up a simple, inexpensive system on an existing oven that was not timer-equipped. When the door of the oven closed, a limit switch was engaged that triggered an interval timer. When the preset time ran out, the timer sent current to a pilot light (a bell could be used just as well) that signaled the operator that the cycle

Fig. 2. Insect trapped in preform and molded-in.

Fig. 3. Preforms being removed from screen and stored in special baskets. Note heights above floor of table and baskets.

was completed. This system is quite inexpensive and easily installed on existing equipment. It has the disadvantage of having to rely on the operator to take the preform out when the light indicates that the proper cure time has elapsed.

A more automatic type of timing generally is preferred. As an example of this type of installation, the timer is triggered when the oven door closes, and the oven door opens automatically when the timer runs out. It also is desirable for a damper to shut off the supply of hot air at this time to reduce heat loss into the room, and to prevent over-curing in case the operator fails to remove the preform at that moment. Further automation can be obtained by incorporating a conveyor to move the cured preforms from the oven, and place the next uncured preform in the oven chamber (see Figure 1).

A company should examine its operations to see what type of timing is best suited to their needs. Again, it must be emphasized that a properly-designed oven with a timed cycle is very important to the production of white preforms.

### Preform Machine

The type of preform equipment also must be considered. The make or type of machine probably is one of the least important of the many factors involved in obtaining white preforms. The important item is to have the preform machine set to make the best possible preform so that the number of problems are minimized and full attention can be directed to color. In a chamber machine, careful and regular cleaning of top and ledges, of course, is necessary. Dusting the machine is not very satisfactory, since the usual immediate effect is to dislodge dust and foreign matter which then gets carried into the air stream during the next few preform cycles, thus making a number of very dirty preforms.

Our operators make it a practice of turning on the preform fan after a cleaning operation to immediately pull any loosened dirt or glass through the machine and out of trouble. We have found the best way to clean up the outside of the machine is a combination of compressed air and an industrial vacuum sweeper. The latter picks up the majority of the dirt, and the compressed air is used to blow it out of the hard-to-get-at cracks and grooves.

So long as good housekeeping is practiced in the shop, less trouble is encountered with the open-type preform machine because of its simplicity of design and lack of a source of dirt.

One segment of the preform machine that is a real trouble-maker is the roving cutter. Most preform machines come with the familiar knife cutting against a rubber roller cutter. Since most standard rollers are black or gray, parts molded with white resin soon acquire a peppered appearance over the surfaces. For the most part, the particles are too small to see in the preform itself. Often by the time this condition is noted, several hundred preforms have been discolored and must be discarded or set aside for molding with darker colors.

For many months we were forced to make frequent roller changes in order to keep rubber out of the preform. Even this was not always successful, since a poorly-adjusted roller starts chipping very quickly after installation. We solved the problem for the most part by using a white rubber roller. The wear resistance of the white rubber was not as good as that of dark rubber, but the service life of the roller was greater since the chips did not show up in the moldings, either against a white or black resin.

The use of white rubber was successful, but only as a stop-gap measure as the roller would wear and chipping would reach a point when discoloration would show in the molded pieces. Our final solution was the installation of a cutter that did not cut against a rubber roller. At least two such cutters are being manufactured currently. One type holds the roving in tension across an air gap and cuts it with a knife; the second type uses carbide cutting blades and has an extremely long service life.

In addition to solving the problem of rubber chips, both of these cutters have aother asset; vastly decreased maintenance time that, in turn, results in a higher production rate. The problem of rubber in the preform is completely and finally eliminated. A cutter of this type could be considered a must for the high-volume production of white parts.

### Contaminants

Once all the proper equipment is obtained and a good binder selected, it would seem that all questions are answered, but often this is not the case. At times it seems that fiber glass attracts dirt like a magnet. Various types of foreign matter may appear in the finished product from many sources. In order to effectively eliminate this foreign material causing discoloration, its source must be found.

Some discoloration comes right from the air itself and, in dusty or smoggy areas, becomes a very serious problem. This type of discoloration appears strongly on the preform-screen side of the molded piece. In other words, if a part is being preformed on a male screen and the preform itself appears white, a gray condition can exist in the finished molding primarily on the inside of the part because of dirt in the air.

This condition generally is easy to spot because the dirt appears in a pattern corresponding to the hole pattern in the preform screen. Although dirt is being filtered out in the entire thickness of preform, it goes back into the air stream and is deposited evenly on the outside of the preform in areas corresponding to the holes on the inside of the preform.

In some industrial areas, the only way out of this difficulty is an isolated preform and oven room that has only filtered air. This may call for expensive filter and duct work, but may be more economical than a high reject rate due to dirty preforms. It is important, also, to keep any dirt- or dust-producing operations away from the preforming areas. We have seen preforms rust colored when welding was being done near the preform machine.

In summer months, bugs can become more than the usual bother by flying into the air stream of a preform machine and becoming preformed-in (see Figure 2). We have had this happen only occasionally, so have not had to take any preventative measures. We would suspect that a spraying of D.D.T. would be the most effective cure in this case.

Other dirt conditions are not so easy to identify and, therefore, are more difficult to correct. This dirt gets on or in the preform from somewhere in the shop. Even when every care has been taken in handling the preforms and keeping them covered and separated from the obvious sources of dirt, trouble still exists. Some common sources of contamination are as follows:

(1). Foreign matter in resin.
(2). Chips of plastic from adjoining presses.
(3). Foreign matter from nearby equipment.
(4). Dirt from floor or material-handling equipment.
(5). Greasy fiber from press strain rods.
(6). Resin from work gloves.
(7). Fibers from operator's clothing.

Foreign matter in the resin usually can be identified by its location in the resin pour pattern. The perform quickly filters out any matter so it will appear on the side from which the resin was poured and in the general area on which it was poured. At times it is hard to find out where such material comes from, so it is a good idea to screen the resin before it is taken to the press. This, at least, will remove the larger foreign matters.

In plants where the molding presses are close together, there is an excellent chance for chips of plastic to be blown from one press to the next or on the preform for the next press. This situation is easily identified. Sometimes a temporary screen separating the presses is the answer. We try to run presses that are located close together on the same color, if possible.

Presses are not the only source of discoloration. Punching operations near where preforms are stored, and sanding operations near the performing also can cause trouble.

Care must be taken to keep preforms elevated from the floor (see Figure 3). No matter how clean the floor may appear, preforms placed on the floor almost certainly will show dirt. Elevating the storage of preforms keeps foreign matter from being kicked into the preforms. It is important to carefully clean any skids, etc., used to hold or carry the preforms. Dirt from the floor usually is localized to only the part of the preform touching the floor.

Very black-smearing fibers showing up only in the molded part are fibers picked up or blown off the strain rods of the presses. This can be a major problem when the part is a tight fit for the press and the preform is rubbed against the strain rods when it is placed in the mold.

In general, the press operators wear work gloves. These quickly become covered with resin, but still are serviceable. However, when an operator changes from black to white production, for example, you will have trouble with old resin from the gloves sticking on the new preform. A change of gloves is required to correct the condition. Also, any rags used to wax the mold should be changed.

Until recently, the last item, fibers from an operator's clothing, was new to us. We were getting discoloration, but the usual corrective measures did nothing. A careful examination showed the dirt to be fibrous and black-and-red in color. A look at the operator's new flannel shirt disclosed the source of these fibers, and a white shop-coat over the shirt corrected things immediately. No matter how far removed a possible source of discoloration might appear, it always should be checked.

### Materials

Other molding considerations are selection of resin, filler, and pigment. Most polyester resins are light enough in color so that they cause no concern. However, there are many resins dark enough in color to cause a marked change in preform color, especially in white. Such resins should be avoided if a light color definitely is required in the preforms.

If fillers are required or desired, very careful selection must be made. There are few fillers, even in the calcium carbonate line, that really are white. Most clays are completely unsuitable; even in two competitive carbonates, different percentages of white pigment are required to obtain the same shade of white in the preforms. If the molding application dictates the type of filler, the only "out" would be a large increase in the white pigment ratio to overcome the color effect of filler.

There are many companies offering pigments designed for polyester molding. If, for some reason, your choice leads you away from proved supplies, be sure that the selection is stable in a polyester resin. Heat stability in matched-die molding also is required.

Surfacing mats and veils of both glass and synthetic fiber have proven very satisfactory in evening-out and intensifying the color of a molded piece. With the same resin mix, a piece without veil will have a greenish tone when compared to a molding produced with veil.

## Conclusions

As our industry expands and more and more successful applications are found, especially in the consumer field, demand for white and pastel colors can be expected to increase.

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# New Styrene for Plastics Lighting Fixtures

**Available accelerated light-exposure tests and discoloration factors are compared and discussed as the basis for evaluating Lustrex "perma tone" styrenes.**

THE popularity of plastic lighting fixtures is increasing rapidly. This is apparent in the results of a recent nationwide survey of architects, engineers, and fixture manufacturers conducted by Dun & Bradstreet for Monsanto. Respondents generally agreed that plastic fixtures offer several clear-cut advantages including low breakage, even light distribution, and light weight. A consequence is that such fixtures are being specified more frequently than ever before.

A hitherto limiting factor in the increasing use of styrene for this application has been a characteristic discoloration of the material on exposure to ultraviolet light. Although many fixture installations have given five-year or longer service life without objectionable yellowing, instances of shorter service lives have been significant in number.

## Discoloration Factors

Laboratory tests have shown that the rate of yellowing (discoloration) is influenced by a number of factors. Styrene containing a relatively high percentage of impurities, for example, yellows more rapidly than pure styrene. Improvements in styrene production techniques and quality control have reduced this characteristic to a minimum.

There are some other factors which affect service life of styrene fixtures: (1). Lamp type and design. The discoloration rate of styrene subjected to ultraviolet light exposure is a function of the intensity and wave length of the light emitted. For example, if we assume "warm white lamps" to have a low discoloration effect of 1.0, several common lamp types would be ranked as follows: DeLuxe Warm White, 4.0; Soft White, 3.5; DeLuxe Cool White, 2.5; Cool White, 1.5; Warm White 1.0; and Daylight, 1.0.

(2). Fixture design. The shorter the distance from the light source to the plastic, the greater is the rate of discoloration (see Figure 1). Fixture designs that limit free-air passage may cause plastic surface tem-

peratures to rise above 130°F., however, thereby accelerating discoloration.

(3). Fixture maintenance practices. In some cases, cleaning agents were retained on fixtures and discolored them. Cleaning-agent action also accelerates discoloration of styrene in some instances. Since commercial cleaners vary so widely in formulation and so frequently are reformulated, however, it is not possible to list the effects of specific cleaner brands on styrene.

### Effect of Additives

Many chemicals are known to improve the performance of styrene by absorbing ultra-violet light more rapidly than styrene itself. Monsanto has developed a series of styrenes containing special additives that absorb ultra-violet light preferentially and yield significant improvements in the color stability of the plastics material. The choice of the most suitable additive involves investigation of such factors as compatibility, heat stability, color quality, and effects on styrene properties. In addition, selection of the optimum ultra-violet light absorber involves the study of available accelerated-aging tests. It is obvious that actual "use" tests would have involved many years of test work before judgment of an acceptable product could be made. Therefore, a method of accelerated ultra-violet light aging had to be developed to meet the following requirements:

(1). The wave-length of the light source must closely duplicate fluorescent light emissions so that extrapolation of short-term testing results will permit estimation of maximum use life.

(2). The test must be sufficiently accurate and reproducible to discriminate between levels of light stability achieved as formulas are varied by either quantity or type.

## Accelerated Tests

A description here of the method, interpretation, and quality of available accelerated aging tests is important to allow existing and potential users of stabilized styrene to be conversant with the methods used to evaluate and to make use-value judgment of the product.

The most commonly used accelerated test of ultra-violet light exposure is the Atlas FDAR Fadeometer, using A.S.T.M. Method D822-46T. This is one of the older methods for testing polymer change under ultra-violet light exposure. The light source is a carbon arc with a Pyrex glass globe that limits the wave lengths of light emitted. Samples are positioned in a cabinet at a fixed distance from the light source and rotated in a vertical plane around the light. Carbon rods must be renewed and the glass filter cleaned daily. Normal test duration is 500 hours.

Due to general availability, this equipment was selected for the IES-NEMA-SPI jointly-proposed specification for Class C (ultra-violet light stabilized) styrene. However, as may be noted from Figure 2a, the spectral curve of the Fadeometer light source radiations shows a maximum intensity at 390 millimicrons. This is considerably different from the spectral curves of light emitted from a 40-watt, T-12 Standard Cool White fluorescent lamp (an average lamp).

Use of this equipment for critical comparisons of stabilizing additives in styrene necessitates careful control of sample black body temperature and cabinet temperature. Environmental temperature is known to further accelerate discoloration if the temperature rises above 130° F. The choice of sample mounting position affects the amount of radiation incident on each sample. Samples to be compared should occupy the same relative position. This point also should be considered in attempts to reproduce results.

A somewhat newer system uses the S-1 Sunlamp (a General Electric 400-watt bulb). The light source has a tungsten filament and a mercury arc without a filter. Samples are rotated in a horizontal plane under the light source. The light-to-plastic distance is as outlined in the test method. Samples are cooled by circulating air kept below 120° F. Normal test duration is 500 hours.

The spectral curve obtained from the S-1 Sunlamp has considerable radiation below 300 millimicrons and, therefore, is not completely representative of the radiation emitted by a fluorescent lamp. (See Figure 2b for a comparison of the S-1 Sunlamp spectrum with that of a typical fluorescent lamp.) S-1 Sunlamp bulbs vary in intensity when new, and decrease in intensity with use. Since the normal test duration and service life of the bulb is approximately 500 hours, it is difficult to obtain consistent light-source intensity during any single test.

A third test method is solar radiation (ASTM Method 1435-56T). Here, the samples are exposed to combined sunlight and skylight on racks facing true south at an angle of 45° to the horizontal. Accumulation of significant data requires exposure times of six months to one year, depending on geographical location.

The typical solar radiation pattern (see Figure 2c) compares closely to that of a typical fluorescent lamp

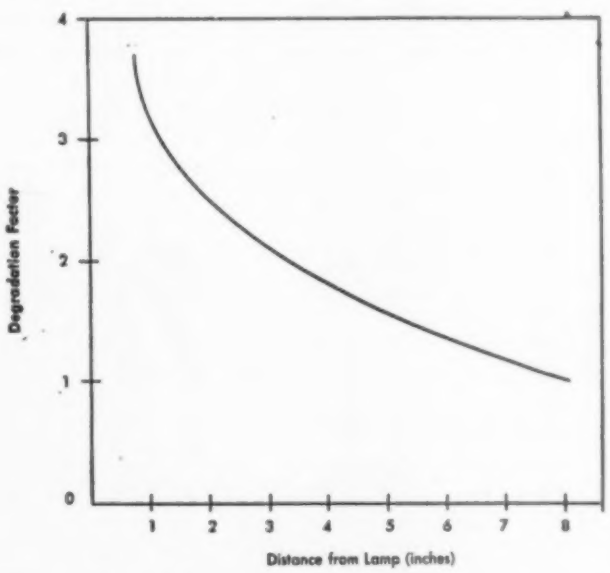


Fig. 1. Effect of fluorescent lamp-to-plastic distance on rate of yellowing of general-purpose styrene, based on 3,000-hours exposure with 40-watt T-12 Deluxe Warm Lamp.

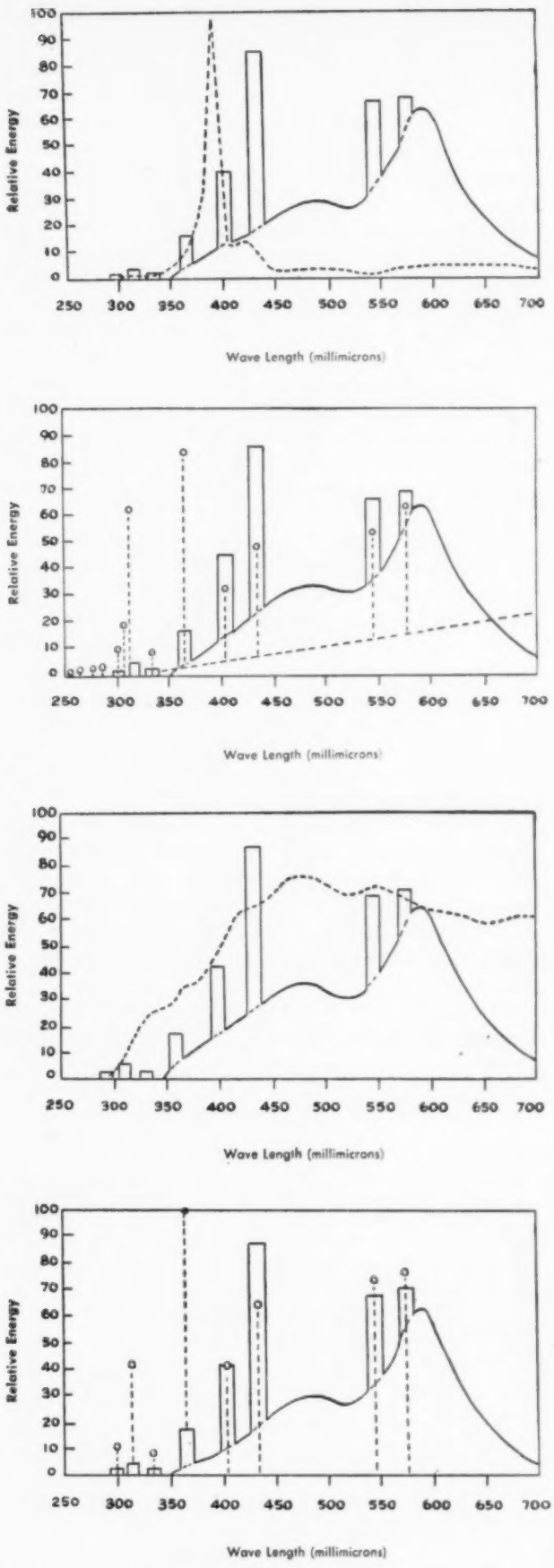


Fig. 2. Effects of wave length on relative energy of emitted light: *Top to bottom;* Atlas Fadeometer; S-1 Sunlamp; Solar energy; and UViarc.

(see Figure 1). The intensity is sufficiently greater to deny the value of this test for judging components that may be used indoors. It does make this type of testing suitable, however, for a somewhat accelerated test for gross judgment of stabilizing systems. Reproducibility problems are obvious since the intensities of ultra-violet light energy of sunlight and skylight vary regionally, seasonally and annually.

A Monsanto research test, UViarc, makes use of equipment similar to that used for ASTM Method 795-49 (a Hanovia #74A-10 700-watt Mercury Vapor lamp with #9700 Corex D glass filter). The light source is a mercury discharge lamp with a glass filter that controls the wave-length of light emitted, and the samples are rotated in a horizontal plane under the light source. A 1.5-inch lamp-to-plastic distance is maintained, and sample temperatures are kept below 120° F. by circulating air. The glass filter that cuts off radiations below 300 millimicrons allows a spectral distribution closely resembling that of the typical fluorescent lamp (see Figure 2d).

The high-intensity light source gives a high aging acceleration factor, making test periods relatively short. Significant judgment can be made after exposures of about 50 hours or less. Since the service life of the light source is long (1,000 hours), reproducibility problems due to changing intensity during a test are not significant.

A fifth test is a Monsanto research test, and consists of actual exposure to fluorescent lamps. Three fluorescent lamps (Standard Cool White) in standard reflecting fixtures are used as a light source. Continuous exposure at 1.5-inch lamp-to-plastic distance yields significant information for judgment after about 1,500 hours.

Discoloration rates are relatively slow by this method. Reproducibility is unsatisfactory for critical judgment, however, since the lamps vary in initial intensity and lose intensity during use. Frequent lamp replacement is required to eliminate those lamps that have become non-representative of their type in intensity.

Sample preparation is important. Although extensive testing has not indicated that lubricants used with styrene affect discoloration, samples should be molded from materials of minimum lubricant. The sample area is important only insofar as sufficient surface is available for measuring and visibly comparing color change. It is important that specimen color and gage be kept standard for comparable results. The samples should be washed before initial and final color readings. A G-E Hardy-type Recording Spectrophotometer is used under ASTM Method D791-54, and the yellowness levels both before and after exposure are calculated in accordance with ASTM Method D791-54.

## Test Results

It is apparent that the two main problem areas in accelerated testing are light intensity variations and duplication of spectral radiations of fluorescent lamps.

The accepted aim of accelerated aging tests has been to develop a time-yellowness change relationship. However, the time acceleration achieved in obtaining the results of acclerated testing, as compared to results

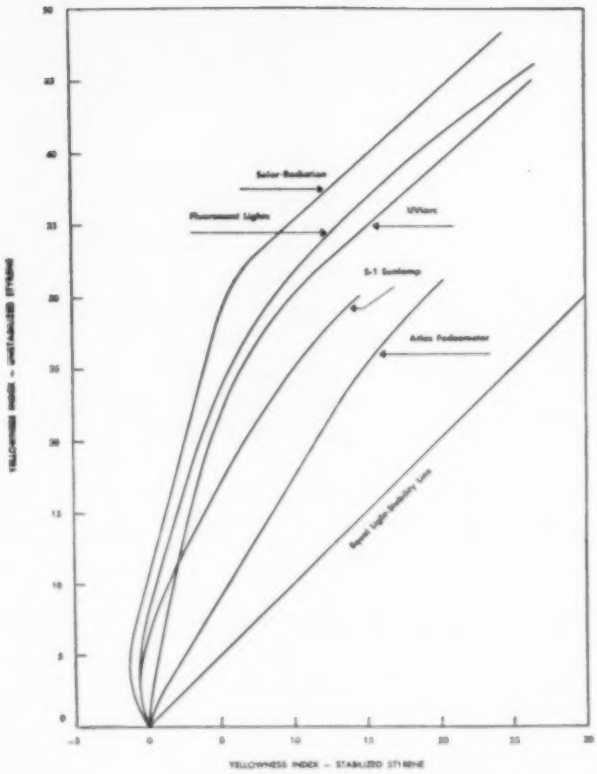


Fig. 3. Yellowness index of stabilized styrene vs. yellowness index of unstabilized styrene with different light sources compensating for light-intensity variations to correlate test results on stabilized styrene when two or more pieces of the same test equipment or different test methods are involved, requiring that a "common denominator" be developed.*

from actual fluorescent-light exposure, is dependent on the intensity of the test light source. Test reproducibility and test values for comparative purposes are dependent on constant intensity. As pointed out previously, variations in the intensity of tests cause varying results in tests run for a fixed length of time.

This variability in intensity has been compensated for during the development work on Monsanto's new Lustrex "perma tone" stabilized styrene by using unstabilized styrene samples as controls. Tests were carried out to a predetermined yellowness level in the control samples rather than for fixed periods of time. As a result, as may be seen in Figure 3, single curves were obtained from data accumulated from tests run at different times with different pieces of the same types of equipment. While Figures 1 and 2 indicate the degree to which the spectral discharges of test light sources duplicate that of a typical fluorescent lamp, Figure 3 shows the following:

(a). The relationship between accelerated tests by Fadeometer, S-1 Sunlamp, solar energy, UViarc, and actual fluorescent light exposure with a common factor of total light exposure.

(b). The degree to which artificially accelerated tests compare with actual fluorescent light exposure.

(c). Performance of stabilized styrene compared to that of unstabilized styrene.

The common factor** of the total amount of light incident on both stabilized and unstabilized samples eliminated the time factor in Figure 3. However, the curves for Fadeometer and S-1 Sunlamp represent 500-hour tests; the UViarc curve represents 144 hours of test; the curve for actual exposure represents 7,500 hours of test; and the curve for exposure to solar energy represents 300 days of test. The "equal light stability line" was added to Figure 3 to depict a stabilizing of no value; i.e., equal to unstabilized styrene. If a more stable styrene is tested and compared to unstabilized styrene, a curve will result that will fall off the "equal yellowness line" if plotted as in Figure 3. The greater the distance from the "equal yellowness line," the greater the effectiveness of the stabilizer being used.

Therefore, it is believed that the following conclusion can be drawn from Figure 3:

(a). At 10 units of yellowing of Lustrex "perma tone" styrene, the Fadeometer test indicates a discoloration resistance approximately twice that of unstabilized styrene; the S-1 Sunlamp indicates 2.5 times the color stability; and exposure to solar energy indicates 3.5 times. Exposure to fluorescent lamps and UViarc indicates that Lustres "perma tone" styrene is approximately two to three times more resistant to discoloration by ultra-violet light than unstabilized styrene.

(b). The UViarc test that utilizes a light source closely duplicating the fluorescent lamp causes discoloration behaviour in styrene that is the most similar to that caused by fluorescent lamp exposure. Exposure to solar energy is next in order.

The value of the UViarc test, therefore, is obvious. Not only does it accelerate the discoloration rate

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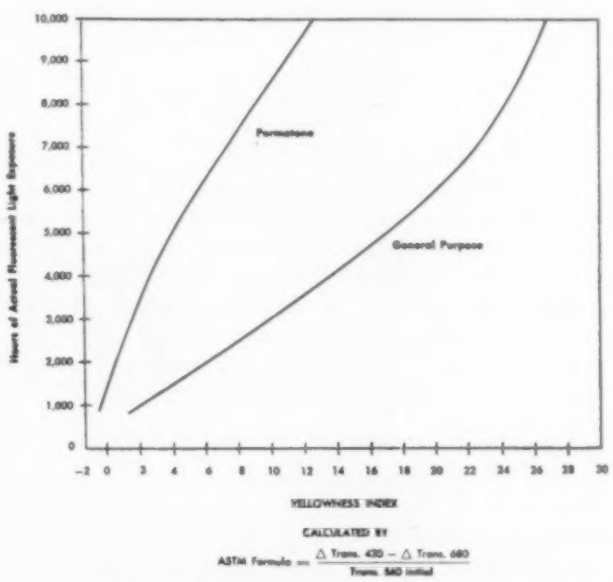


Fig. 4. Effects of fluorescent light-exposure time on yellowness index curves for Perma tone and general-purpose styrenes.

*This "common denominator" would minimize the effect of light-intensity variation between different units of the same design or test units of another design by essentially equalizing the total light incident on a sample regardless of the light source. The "equal light-stability line is drawn to represent the hypothetical case where both stabilized and unstabilized styrene discolor equally; i.e., no stabilization is achieved by the styrene additives. Thus, the degree of improvement achieved by a stabilizing system can be measured by the extent to which a curve varies from the "equal light-stability line."

**See footnote for Figure 3.

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# Engineering Aspects of Polystyrene

**A comprehensive review of material types, factors affecting physical properties, stress considerations, and injection molding design principles.**

THE types of polystyrene available today can be divided into three general groups, as follows: (1). Polystyrenes that have not been changed by the addition of modifiers. (2). The shock-resistant or impact types whose physical properties have been altered considerably through the use of modifiers. (3). The chemical-resistant materials; copolymers of styrene with some other monomer especially formulated to increase the chemical resistance of the end product.

## General-Purpose Types

The general-purpose materials could be called the "cast iron" of the polystyrene family. Much like cast iron, these materials are satisfactory for a wide variety of applications, but have some limitations due to their inherent physical properties. These materials are used very effectively in applications where rigidity and appearance are important. They are available in a wide range of colors including crystal clear; possess excellent electrical properties; and have a low specific gravity and a low water absorption rate.

These materials are not, however, suggested for usage in applications requiring high elongation and toughness. A property chart of general-purpose materials, see Table 1, emphasizes this point. The tensile strength of these materials measured by the standard ASTM test is comparatively high at 4,500-8,200 psi., with 6,000 psi. generally accepted as typical. The impact strength is rather low, ranging from 0.25-0.46 foot-pounds per inch of notch. The range of impact strength of general-purpose phenolic molding compounds is about the same.

The elongation range for these materials is 1.2-2.2%, and the modulus of rigidity is about 450,000 psi. This is near the top of the stiffness range for thermoplastics. General-purpose materials include both easy-flow and standard-flow compounds.

Other important materials in this group are the high heat-distortion formulations. The heat-distortion tem-

Table 1. Polystyrene Types Property Chart.

| | General-Purpose | Shock-Resistant | Chemical-Resistant |
|---|---|---|---|
| Tensile strength, psi. | 4,500-8,200 | 2,900-7,500 | 9,500-11,700 |
| Modulus of rigidity, $10^5$ psi. | 4.5-5.0 | 2.5-5.0 | 4.6-4.7 |
| Elongation, % | 1.2-2.2 | 10-50 | 2.5-3.6 |
| Impact strength, ft. lbs./in. of notch | 0.25-0.46 | 2.0-9.0 | 0.33-0.45 |
| Heat distortion temp., °F.: | | | |
| As molded | 155-205 | 155-185 | 175-200 |
| Annealed | 165-215 | 170-204 | 210-215 |

Table 2. Fiberglass-Filled Polystyrene Property Chart

| | Fiberglass-Filled Polystyrene | General-Purpose Polystyrene |
|---|---|---|
| Tensile strength, psi. | 10,500-14,500 | 4,500-8,200 |
| Modulus of rigidity, $10^5$ psi. | 12.0 | 4.5-5.0 |
| Elongation, % | 0.75-1.0 | 1.2-2.2 |
| Impact strength, ft. lbs./in. of notch: | | |
| At 77° F. | 2.0-2.5 | 0.25-0.46 |
| At-40° F. | 2.0-2.5 | 0.25-0.46 |
| Heat distortion temp. as annealed, °F. | 218-222 | 155-205 |

perature of general-purpose polystyrene is in the range of 155-185° F. The high-heat materials may have distortion temperatures as high as 205° F., unannealed. This occurs under ideal molding conditions.

Typical applications of general-purpose materials include wall tile, food containers, rigid packages, brush backs, pharmaceutical containers, and hundreds of others. The high-heat materials are used extensively for radio cabinets, coil forms, dial faces, and other applications that require a minimum percentage of volatile ingredients.

## Shock-Resistant Types

Because of the need for a material with greater elongation and impact strength, the shock-resistant or impact-grade polystyrenes were developed. Elongation and impact strength are increased by the addition of rubber-like modifiers. These materials might well be called the "steels" of the polystyrene family for "toughness" has been added to their characteristics. The development of these materials resulted in many new fields of application for polystyrene.

Comparison of the physical properties of shock-resistant grades with the general-purpose materials (see Table 1) illustrates the increase in elongation and impact strength; the elongation improvement ranges from 10-50%, while the increase in impact strength ranges from 2.0-9.0 ft. lbs. per inch of notch. A further study of the property chart shows some reduction in tensile strength. Thus far, no one has been able to increase impact strength and elongation without losing some tensile strength. The modulus of rigidity varies over a wide range from 200,000-500,000 psi., depending on the formulation used.

Shock-resistant materials are subdivided into four groups; including medium impact, high impact, and

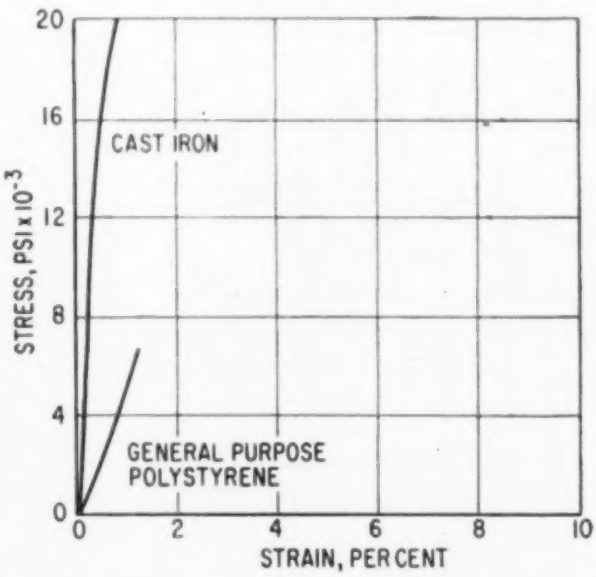


Fig. 1. Stress-strain curves for cast iron polystyrene.

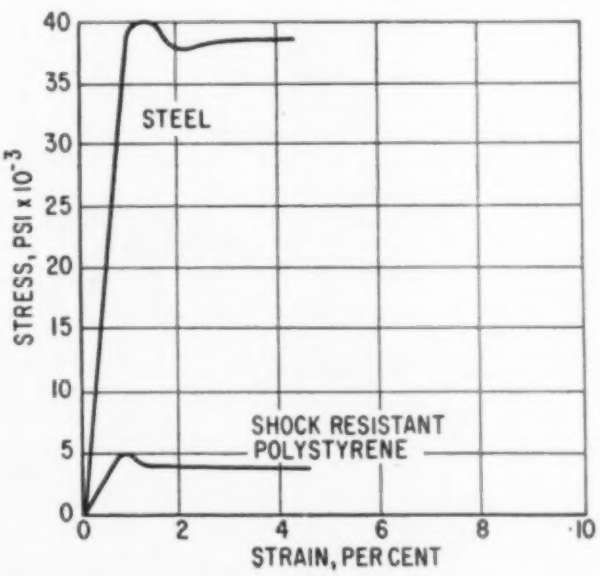


Fig. 2. Stress-strain curves for steel and shock-resistant polystyrene.

Table 3. Storage Stability of Polystyrene.

| Exposure Time | Tensile Strength, Psi. | Elongation, % | Unnotched Impact Strength, Ft. Lbs. | Visual Color Change |
|---|---|---|---|---|
| Indoor Storage, White Shock-Resistant Type: | | | | |
| Blank | 4,950 | 30 | 18 | None |
| 6 Months | 5,080 | 15 | 14 | None |
| 1 Year | 5,090 | 20 | 16 | None |
| 2 Years | 5,180 | 25 | 17 | None |
| 3 Years | 5,140 | 28 | 17 | None |
| Bright-Light Indoor Storage, Shock-Resistant Type: | | | | |
| Blank | 4,950 | 30 | 18 | — |
| 1 Year | 4,790 | 16 | 6 | None |
| 2 Years | 4,800 | 14 | 5 | Very slightly yellowed |
| 3 Years | 4,930 | 11 | 4 | Slightly yellowed |
| Outdoor Storage in Midland, Mich., Shock-Resistant Type: | | | | |
| Blank | 4,950 | 30 | 18 | — |
| 6 Months | 5,050 | 16 | 7 | Slightly yellowed |
| 1 Year | 5,120 | 15 | 6 | Visibly yellowed |
| 2 Years | 4,940 | 8 | 3 | Yellowed |
| 3 Years | 5,340 | 6 | 3 | Yellowed |

super-high impact materials. Another important type which has appeared recently is the high-heat, high-impact formulation.

One of the largest applications for shock-resistant polystyrenes is in refrigerator innerdoor liners. Other large-volume applications include toys, radio cabinets, battery cases, drawers, containers, furniture drawers, storage bins, flashlight cases, and household appliance housings.

## Chemical-Resistant Types

The third group of styrene-derived polymers is made up of the chemical-resistant materials. This adds a "stainless steel" classification to the family. The principal material in this group at present is a copolymer of styrene and acrylonitrile. This copolymer has increased chemical resistance, a higher heat-distortion point, and moderately greater toughness in comparison with general-purpose polystyrenes.

Comparison of the properties of chemically-resistant materials with general-purpose and shock-resistant groups also is given in Table 1. A typical tensile strength value is 10,500 psi. and elongation about 3%. These values range up to twice those of general purpose polystyrene and account for somewhat greater toughness.

The heat distortion temperature is about the same as heat resistant formulations of general purpose polystyrene. The modulus of rigidity is the same as general purpose polystyrene.

These materials generally exhibit better resistance to most organic compounds than general purpose polystyrene and good resistance to acids, bases, salts, oils, waxes, soaps, detergents and foodstuffs. Some typical

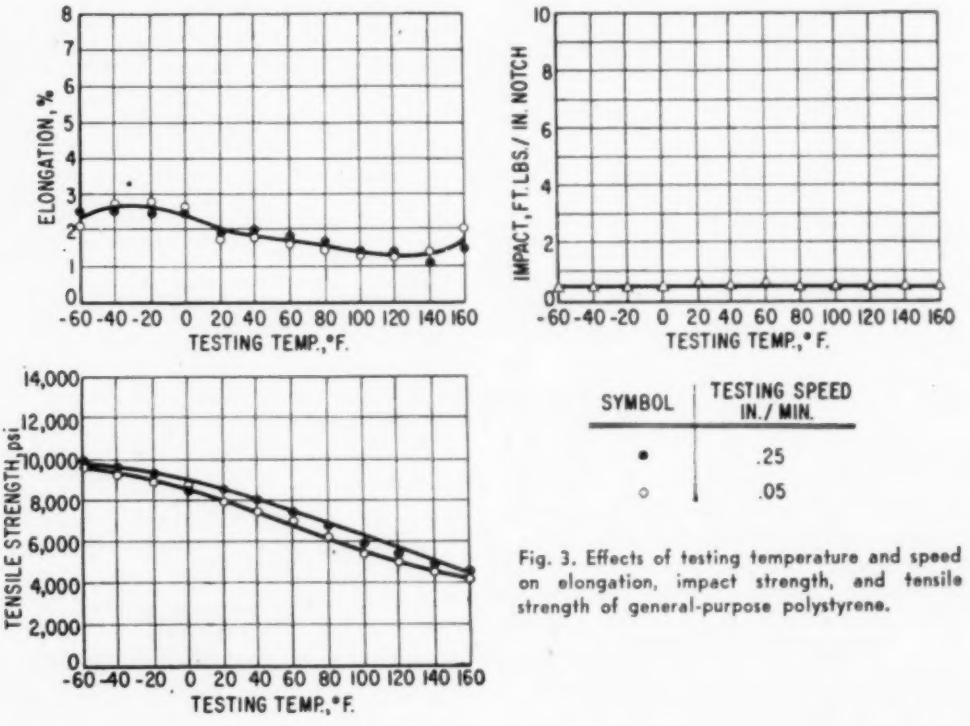


Fig. 3. Effects of testing temperature and speed on elongation, impact strength, and tensile strength of general-purpose polystyrene.

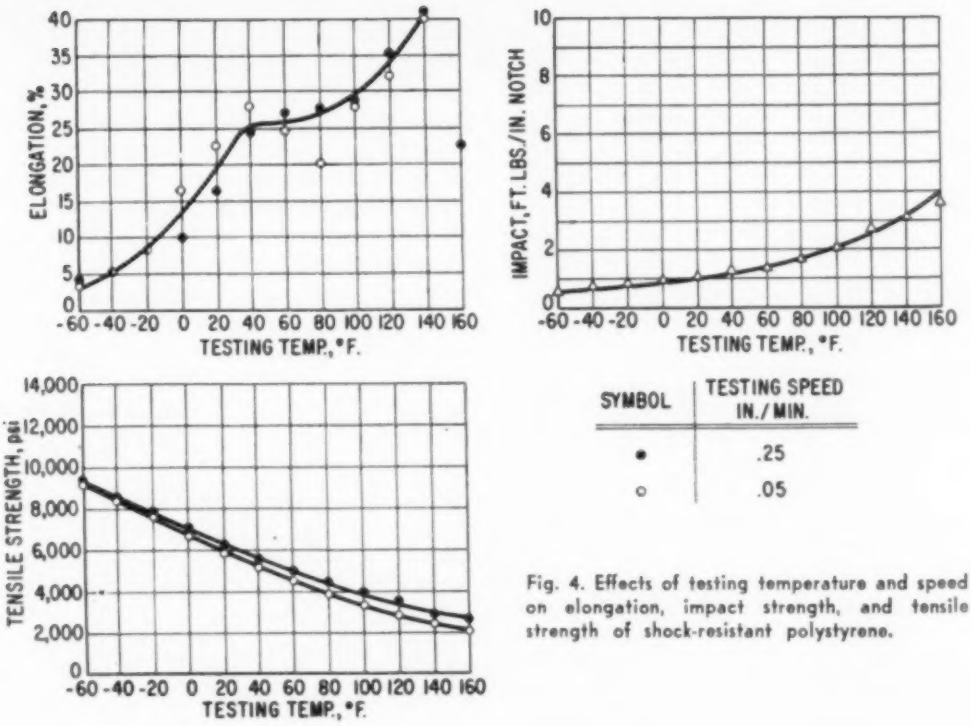


Fig. 4. Effects of testing temperature and speed on elongation, impact strength, and tensile strength of shock-resistant polystyrene.

uses include drinking tumblers, oil filter bowls, medical equipment components, and refrigerator parts.

## Glass Fiber-Filled Types

Several types of polystyrenes, because of their unique properties, require separate discussion. The first of these is the glass fiber-reinforced polystyrenes.

Fibrous glass-reinforced polystyrene is a high-heat formulation to which glass fibers have been added. The result is a material with increased stiffness, tensile strength, impact strength, and dimensional stability (see Table 2). The increase in physical properties is determined to a large extent by the amount of glass added to the plastic. The values shown are for a formulation containing 35%, by weight, of glass fibers. This is the maximum allowable percentage of glass, since further increases make injection molding extremely difficult.

The increase in tensile strength and impact strength gives indication of the increased toughness of this material. A decided increase in heat distortion temperature also is evident. The low elongation, high tensile strength, excellent heat distortion point, and good impact strength suggest the use of this material in applications of extreme loading at both high and low

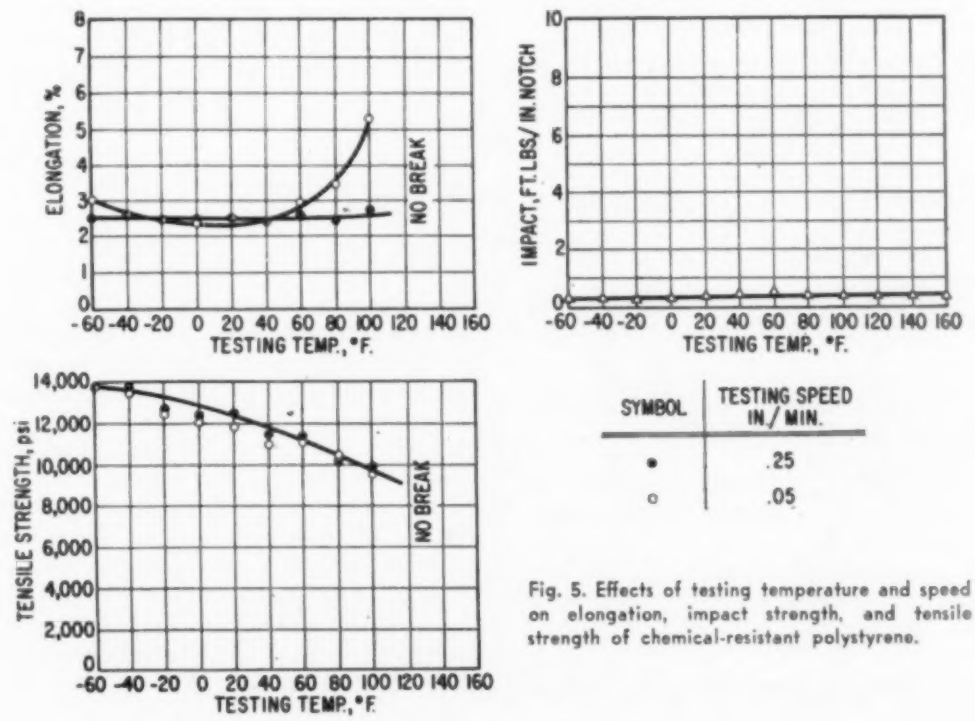


Fig. 5. Effects of testing temperature and speed on elongation, impact strength, and tensile strength of chemical-resistant polystyrene.

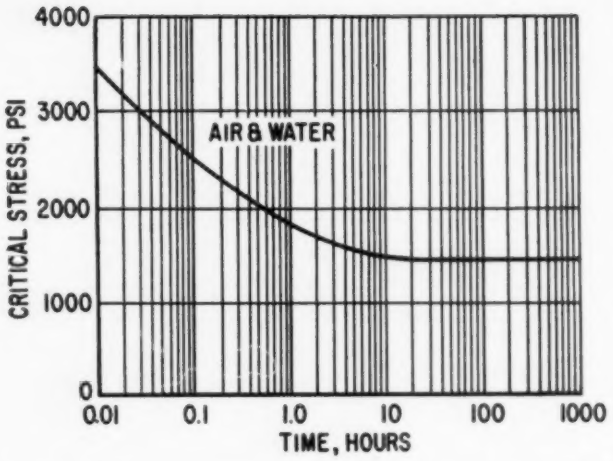


Fig. 6. Time dependence of crazing at 75° F. of compression molded general-purpose polystyrene.

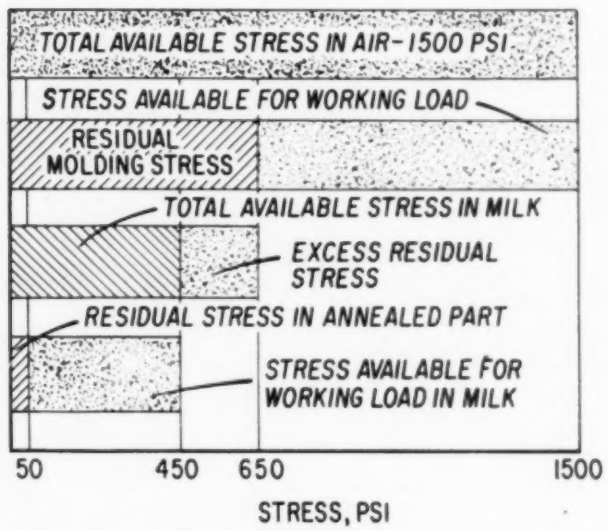


Fig. 7. Environmental effect on available working stress for general-purpose polystyrene.

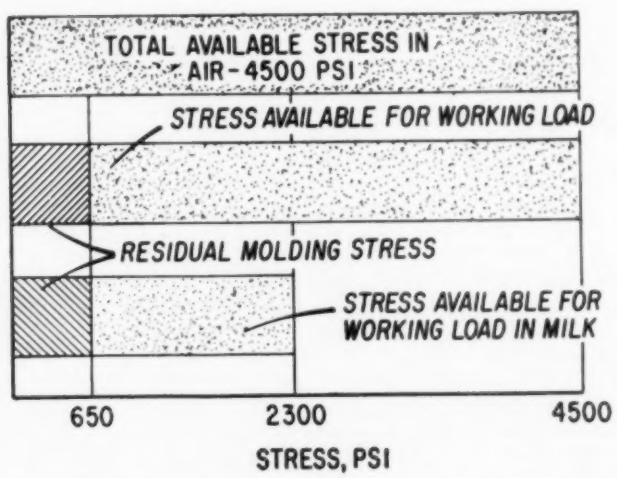


Fig. 8. Environmental effect on available working stress for chemical-resistant polystyrene.

temperatures.

Weld lines in parts molded of this material tend to be weak, since there is no way to obtain bridging of glass fibers across the weld between two plastic fronts. Welds, therefore, should be avoided as much as possible. Non-uniform sections and designs requiring core pins should be held to a minimum.

This material exhibits very low mold shrinkage, approximately 0.001-inch per inch. On prolonged heating, the heat distortion temperature approaches that of high-heat polystyrene. Exposure for up to one hour results in the distortion value given in Table 2. For exposures of six hours or more, the heat distortion temperatures should be considered equal to that of high-heat polystyrene.

## Physical Property Factors

In discussing physical properties of polystyrene, it should be pointed out that plastics are engineering materials. They exhibit the same properties as do metals; stress-strain curves can be plotted for them; they are subject to distortion due to heat; they stress crack; and they creep much the same as do metals.

One of the most obvious and important differences between plastics and metals is the range of temperatures, pressures, and conditions over which these physical changes occur. For example, the stress-strain curves of general-purpose polystyrene and cast iron may be compared as shown in Figure 1. The cast iron broke at a unit stress of 20,000 psi., while the polystyrene broke at a unit stress of 6,500 psi. Although tensile strength and modulus of rigidity are in different ranges, the behaviors of the two materials in tension are similar.

Figure 2 shows the stress-strain curves for steel compared to shock-resistant polystyrene. The shapes are similar, but the ranges of values are different.

The effects of temperature, aging, and other environmental conditions on the physical properties of polystyrene are of critical importance in mechanical design. These effects are being studied and tabulated in laboratories and through actual performance records. Plastics are relatively new engineering materials and do not have the benefit of the long history of wood, for example. However, a considerable amount of information is available.

### Temperature Effects

Test results at various temperatures show significant changes in physical properties of polystyrene. Figure 3 shows the effects of testing temperature and speed on general-purpose polystyrene. An increase in temperature from 80° to 140° F. results in approximately a 2,000-pound decrease in tensile strength. The decrease is about 30% and the importance of including it in design calculations is obvious.

The effects of testing temperature and speed on the shock-resistant materials is more pronounced, as Figure 4 illustrates. All three properties (elongation, tensile strength, and impact strength) are affected greatly by temperature. ASTM impact-strength values usually are reported only at 77° F. The impact strength at 140° F. is likely to be much greater, and may be dangerously low at 30° F.

Figure 5 shows the testing temperature and speed effects on the chemical-resistant materials. These curves are presented for reference only, without further discussion.

### Aging Effects

The properties of polystyrene are also affected by aging. Table 3 shows the results of a three-year test on a shock-resistant polystyrene held in a dark storeroom. There was no appreciable change in physical properties during this period.

Table 3 also illustrates the effect of exposure immediately inside the glass of a north window; the degradation was appreciably more severe. The most severe loss of mechanical strength was experienced during the first six months of exposure, after which the additional losses were small by comparison. The properties are relatively stable after the initial change, and designs have been based on the values reported.

At present, no commercially-available polystyrene formulation will not suffer serious mechanical degradation when subjected to outdoor exposure; this is especially true of the shock-resistant materials. Table 2 also shows the effect of three years' outdoor exposure in Midland, Mich. While tensile strength remained essentially constant, elongation, impact strength, and color were affected seriously.

Conclusions drawn from the data presented in this tabulation indicate that polystyrene is stable when average indoor exposure is involved. Polystyrene loses too much of its original strength during outdoor exposure to be recommended for general use.

### Environmental Effects

Plastics may come in contact with various reagents that affect their properties. The result is stress cracking or crazing; a failure analogous to stress corrosion in metals. Crazing is the development of fine cracks on or under the surface of a plastic due to a combination of factors such as mechanical loading, environment, and internal stress levels. These cracks may range from those of relatively large size; visible to the unaided eye, down to those of almost microscopic size. Critical stress has been defined as the stress at which crazing occurs.

Figure 6 illustrates the crazing time-dependence of general purpose polystyrene in contact with air or water. The critical stress above which crazing occurs is about 3,500 psi. for instantaneous loading; decreases to about 1,500 psi. when the loading is applied for 50 hours; and then does not change appreciably for longer load-bearing times. This means that polystyrene can withstand a load of approximately 1,500 psi. for an indefinite period, at a temperature of 75° F. and in contact with air or water, without breaking.

The safe stress level is reduced further by more severe environmental conditions and internal residual molding stresses. Figure 7 shows how internal stresses affect the available working stress of general-purpose polystyrene externally-applied loads. The maximum working stress for the general-purpose material is 1,500 psi. Laboratory tests have shown residual molding stress levels as high as 650 psi. Under this condition, the available working stress in contact with air or water is reduced to 850 psi.

If this material were to be used in an application involving contact with whole milk, for which the critical stress is 450 psi., the part would craze by itself because the residual stress is greater than the critical stress. If the molded part were annealed thoroughly, the residual stress would be about 50 psi. The part then would have 400 psi. available working stress in milk and 1,450 psi. available in air or water.

### Chemical Resistance

The copolymer of acrylonitrile and styrene may be considered similarly in Figure 8. The critical stress in air is 4,550 psi. If the residual stress is 650 psi., the available working stress is about 3,900 psi. The critical stress in milk is 2,300 psi., and a molded part having 650 psi. residual stress would not craze because it still retains 1,650 psi. available working stress.

Resistance to stress cracking in contact with various reagents must be established for each reagent, plastic, temperature, and time condition. A considerable amount of data is available for both general-purpose polystyrene

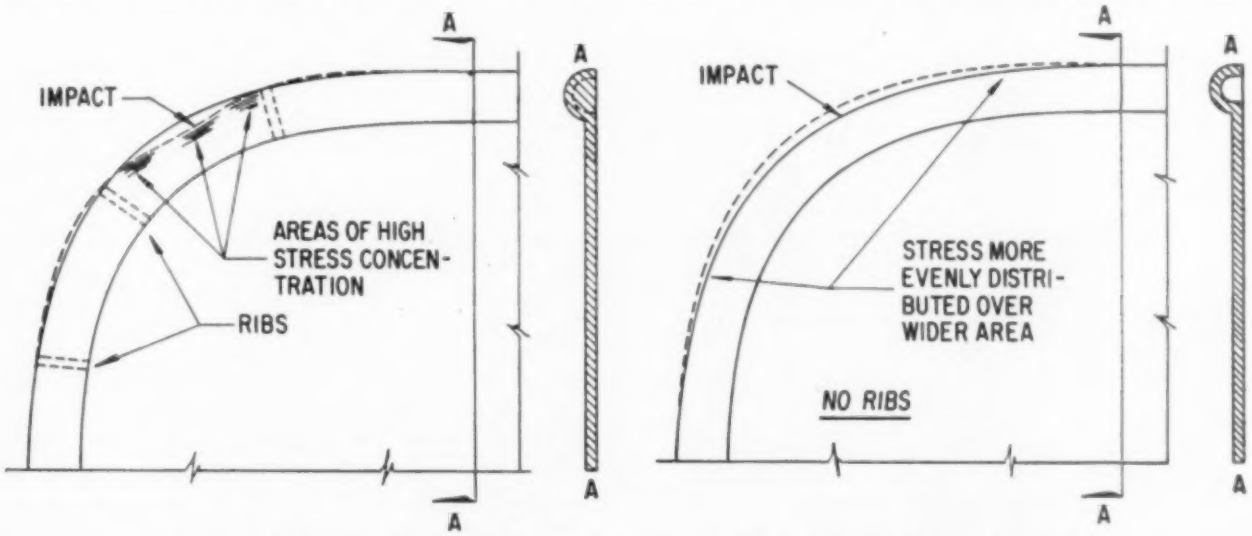


Fig. 9. High-chair tray designs: (left) poor design due to ribs; (right) good design with no ribs.

and acrylonitrile-styrene copolymer. The two materials do not behave always in the same fashion, as has been shown for milk.

Critical stress is a relatively new measure of chemical resistance that needs to be added to the time-honored measurements of swelling, softening, dissolving, gain or loss of weight, surface effects, color change, and oxidation. Some reagents that do not show any appreciable effects under the older chemical-resistance tests have caused serious decreases in critical stress.

### Moisture Absorption

The moisture absorption of polystyrene is so low that there are no effects on the material's mechanical properties. Changes in dimensions due to moisture absorption are negligible.

### Dimensional Stability

Polystyrene has excellent dimensional stability when compared with other thermoplastics. In designing parts, however, some allowance must be made for mold shrinkage and thermal expansion. It is not possible to predict mold shrinkage exactly. This shrinkage may be in the magnitude of 0.002-0.005 inches per inch of length. It is suggested that the tolerance on molded parts be not less than 0.001 inches per inch of length on any given dimension to allow satisfactory fabrication limits and proper fit of mating parts under various ambient temperature conditions.

The coefficient of thermal expansion is relatively high as compared with metals; approximately $4.5 \times 10^{-5}$ inches per inch per °F. (The coefficient expansion for steel is $6.5 \times 10^{-6}$ in./in./°F.) The coefficient for polystyrene is approximately 15 times that of steel, and this fact should be kept in mind in product design.

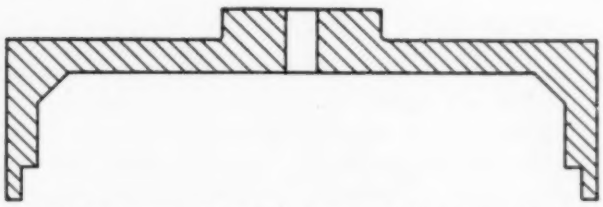

Fig. 10. Poor cross-sectional thickness variation with polystyrene.

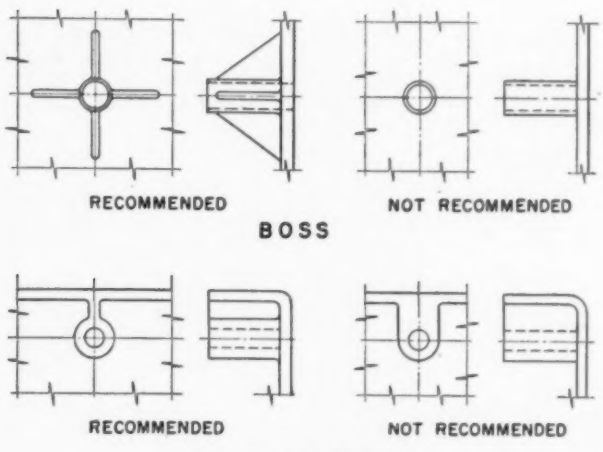


Fig. 11. Recommended and unrecomended boss designs for use with polystyrene moldings.

## Design Fundamentals

Mechanical design should be based on the engineering properties and available forms of the plastic. Mechanical design for other engineering materials has been based exactly on these two factors. Toilet seats have been made of a thick flat piece of wood because of the available form of the wood. Strength and durability have been accepted as proportional to thickness.

Polystyrene can be molded into almost any shape, but there are disadvantages in trying to mold it an inch thick. It is suggested that better function design, strength, and economy could be derived by designing plastic toilet seats around the engineering properties of polystyrene, rather than by trying to make them imitate wood.

## Stress Considerations

Stresses in a plastic part include those caused by mechanical loading, differential cooling, orientation of molecular chains, and localized overheating during machining. Packaging stresses also may be present because of improper molding conditions.

The first three causes of stresses can be controlled directly by the design engineer. In designing a part that must withstand an external load, concentrated stresses should be avoided. The part should be designed so as to distribute the energy absorption over as much of the part area as possible. A reinforcing rib placed to give added stiffness often will result in an area of concentrated stress. Hence, after a short period under load, the part will fail.

Rigidity is not always the best indication of product strength, especially if this rigidity is gained by concentration of stresses. In many cases, it is better to increase the over-all sectional thickness of the part to avoid using ribs. The resulting parts will be somewhat more flexible, but will be stronger because the stresses are distributed more evenly over the entire part.

The highchair tray, shown in Figure 9 (left) is an example of a too-rigid design where ribs were used extensively. When the tray was dropped on its edge, the force of the impact was concentrated between two ribs, and the rim broke. When the tray was molded without ribs, as shown in Figure 9 (right), the force of impact was spread, the deflection was less, and the rim did not break.

Thermally-induced stresses caused by differential cooling of the part can be reduced by proper design. Figure 10 is a cross-sectional view of a part having extreme differences in sectional thickness. As this part cools after fabrication, the thinner section will cool more rapidly. Subsequent cooling and shrinkage of the thick section will cause a sufficient amount of bending in the already-hardened thin section and introduce tensile stresses of sufficient magnitude as to cause crazing under small loads. If the part had been designed to minimize this variation, it would have been much stronger due to the decrease of internal stress. It is recognized that some variations are necessary occasion-

ally. If they become necessary, adequate knowledge and forethought usually can bring about an arrangement of thickness design in a manner that will assist, rather than impede, the molding process.

Orientation stresses caused by forced molecular alignment can be controlled to some extent by the design engineer. Orientation stress is present in all thermoplastic parts and is the direct result of the fabrication method since injection molding, extrusion, and vacuum forming all force the material to flow in a definite direction, resulting in molecular alignment. The strength of the part in a direction parallel to the flow is high, but the properties of the part perpendicular to the flow will be considerably less. The designer, therefore, should consider the fabrication of the part and avoid placing requirements of maximum strength across the direction of orientation.

## Injection Molding Design

Injection molding is the most universal method of fabricating polystyrene parts, and parts manufactured by this technique can be of almost any size and shape. A number of factors should be considered in product design for injection molding.

Control of sink marks by proper flow of plastic in the mold is an important product design consideration. Sink marks may be brought under control to a considerable extent by avoiding heavy sections, heavy ribs, bosses, and large fillets. Heavy sections can make injection molding very difficult, not to mention their effect on the physical strength of the part. Bosses should be designed so as to minimize stress concentrations. By designing bosses as recommended in Figure 11, section thickness is kept to a minimum, and the possibility of sink marks and stress concentrations is reduced.

Ribs should be avoided whenever possible. They constitute a variation in section thickness and, therefore, may result in sink marks, stresses, and a complex flow pattern in the mold. If ribs do become necessary, it is recommended that their height be held to a minimum. The rib thickness, (see Figure 12), should be approximately 0.015-inch thinner than the section to which it is attached. The radius at the point of attachment should be approximately 0.005-0.010-inch. Large fillets at the intersection of two perpendicular surfaces do not result always in better strength. The effect of a large fillet is to increase the cross-section area at the joint, resulting in increased internal stress and a weakened joint.

Wall thickness in the range of 0.060-0.125 inches is molded most easily and rapidly. If the wall is too thin, the material will chill too rapidly while the mold is filling. This makes mold-filling difficult, and extreme orientation stresses result. On the other hand, walls that are too thick require long molding cycles. Draft angle or taper should be used to facilitate removal of the part from the mold. As much as 1° of draft is desirable if the design permits, although as little as 0.2° or 0.003-inch per inch has been used.

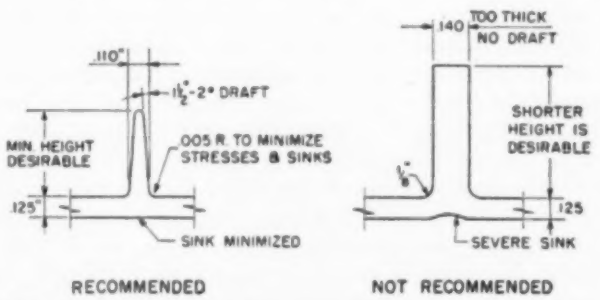


Fig. 12. Recommended and unrecommended rib designs for use with polystyrene moldings.

Weld lines are formed whenever the flow of plastic is required to pass around an obstruction such as a very thin section or core pin (see Figure 13). When the plastic meets on the opposite side of this obstruction, a weld line results. The strength of these weld lines is approximately 70-80% of the original strength.

A review of the stress-strain curve for shock-resistant polystyrene illustrates the loss of tensile strength and elongation at a weld (see Figure 14). The curve for a test bar gated at one end is shown (left). When a test bar is gated at both ends, and a weld occurs in the center of the piece, the bar breaks abruptly during a tensile test as shown by the second curve (right). The elongation of the weld bar is much reduced because of the breakage at the weld.

Use of metal inserts is another factor that requires careful design. General-purpose materials usually cannot be molded successfully around an insert because of their low elongations. The difference in the coefficients of expansion of the metal and the plastic will

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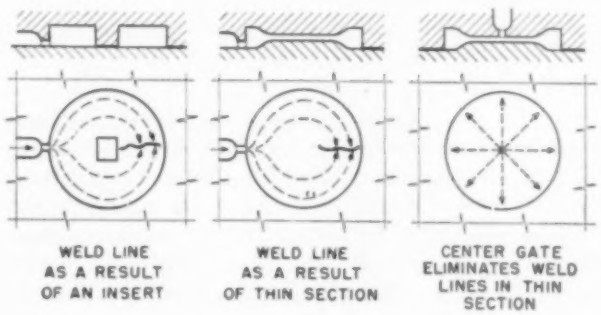



Fig. 13. Effect of injection molding design on weld lines.

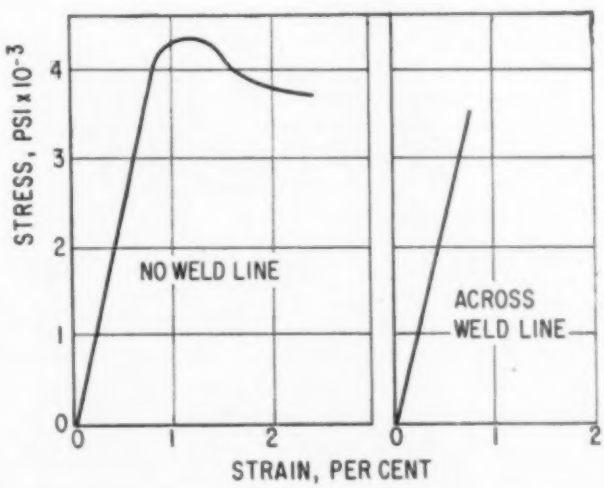


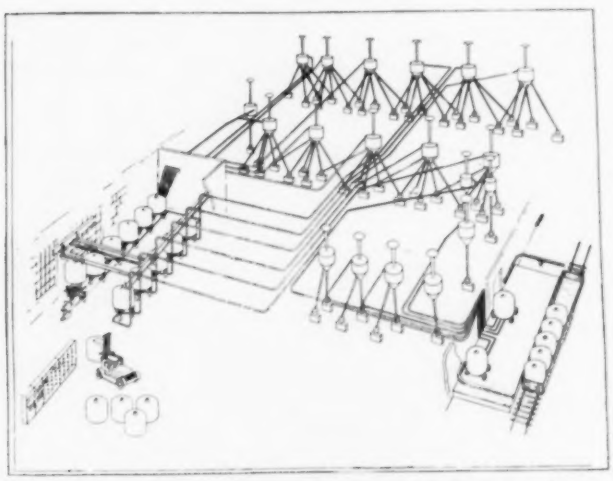

Fig. 14. Stress-strain curves for shock-resistant polystyrene.

View of *Western Electric's Point Breeze Works* shows distribution manifolds and insulating extruders.

# High-Speed Pneumatic Conveyor System

NEW and improved methods of insulating and sheathing telephone cable posed a multi-phase handling problem for *Western Electric Co., at its Point Breeze Works, Baltimore, Md.* The firm uses colored polyethylene for insulation, black for sheathing; instead of the paper and lead formerly employed. In actual practice, this involves the distribution of 11 colors of polyethylene to 52 different extruders.

The old method of materials handling could be described as follows: material was received in 50-pound bags, palletized, moved to store rooms, trucked to production areas, and hand-emptied into the extruder hoppers. Disadvantages were high materials-handling costs and contamination. *Western Electric* engineers came up with a system of pneumatic distribution using U. S. Rubber Sealdbins, a collapsible neoprene-fabric container, thus solving the problems of shipping and storage. Each Sealdbin contains 9,400 pounds of $\frac{3}{16}$-inch diameter polyethylene pellets.



Schematic drawing of Dracco *Western Electric* materials-conveying system.

Working with engineers from the Dracco Division of Fuller Co., the *Western Electric* men designed an over-all pneumatic conveyor system for transporting the pellets to 44 insulating and eight sheathing extruders for distances up to 720 feet from the receiving areas. Two conveyor systems were installed at opposite ends of the building, one for handling insulating materials, the other for sheathing compound. Flexible sleeves from the Dracco feeders are attached to the unloading socks on the Sealdbins; thus, the polyethylene is delivered to the extruders in virtually the same degree of purity as it was on leaving the supplier's plant.

Conveying lines are suspended with hanger rods from roof steel, and are run through roof trusses in parallel or right-angle runs. Bends using 30-, 45-, 60-, and 90° elbows are fixed with angle brackets to eliminate sway. These lines lead to distribution mani-

*(Continued on page 658)*

*Guest Editorial*

JOHN BACHNER, *President,*
*Chicago Molded Products Corp.*
*Chicago, Ill.*

# Shock Troops of the Industry

CUSTOM molders, like many other industrial groups during these last few "recession" months, have had their share of disappearing markets. Many of us have called in management consultants, tightened our belts, and polished our sales and promotion tools. We've tried to replace dead wood with solid timber, brighten up our corporate look. Fine. But as a group, I think we're in danger of forgetting an important essential for *any* successful business operation—our origin and our aims.

Custom molders are the *shock troops* of the plastics industry. By that I mean that it has been the custom molder, big or small, who has provided the testing ground for the new and "revolutionary" materials, been the point of contact between the material supplier's pilot plant, the machinery maker's new press, and the customer's needs. If you'll look back to the beginnings of our industry—back to the time when plastics meant either "Celluloid" or "Bakelite"—you'll find this generally to be the case. Men with fortitude and imagination—with just plain guts—took the phenolics and the ureas and the acetates into their backyard shops, found ways to make them mold, then went out and obtained orders to keep their machines running round the clock.

As each new material came along—the melamines, the styrenes, the vinyls, the polyethylenes—we've done the same, and we've prospered doing it! Custom molders have moved from the corner garage, the old abandoned warehouse, the galvanized and tar paper shack to well planned factories and shops. We've turned native ingenuity and sweat into engineering know-how and imaginative design. Or until now we have.

Today, more and more custom molders are *custom* molders in name only. Some of us have gone *captive:* become the molding division of some bigger corporate entity. Others have become *specialists,* putting out the same job month after month, a job that some other molder may have researched and developed. Well and good. But as custom molders retire from the field, from where will the spirited progress come? Who will field-test the new machines and the revolutionary materials? Who's going to sell management on the new and better plastics, the unusual applications, the cost saving, and the more efficient jobs?

We at Chicago Molded Products have been custom molders for 39 years. We think the need for the custom molder in today's market is greater than it has ever been, and that it is up to all custom molders, singly and together, to continue the creative and pioneering activity that has meant so much in the past to the plastics industry. That's why we've chosen to sponsor the Bachner Award. By offering this award to product manufacturers, we hope to recognize and stimulate outstanding contributions to the *practical* applications of molded and formed plastics to industry. Through the Award, we seek to encourage more manufacturers to use plastics in the initiation and improvement of their own products.

The Award itself is an inscribed plaque and $1,000, and it is our current plan to offer it every two and one-half years, concurrent with the SPI's National Plastics Exposition and Conference. A special Committee working through the SPI is administering the Award this year and is accepting applications and nominations through August 15th. Any end-product manufacturer (or his designer or molder) can nominate a molded item. We believe this is a good way for our industry, the custom molding industry, to help itself grow. Perhaps *you* may be considering another.

—THE END

*Edited by:*
HARRY T. DOUGLAS,
*Executive Vice President,*
*Lunn Laminates, Inc.*
*Huntington Station, N. Y.*

# Reinforced Plastics

## Suggestion Systems Inadvisable for Small Plants

BECAUSE of the romance, unexplored vistas, and costly mistakes associated with reinforced plastics molding, the field is a hot-bed for suggestions, improvements, and other thoughts that everyone and his mother-in-law are eager to offer. So many articles have been written extolling the virtues of plant suggestion systems that it seems almost sacrilegious to say that they may be wasteful, useless, and an ill-will promoter, but I think that they often are.

Small plants throughout the country are continuing to run suggestion systems with colorful boxes placed conspicuously around the plant so that one, so inclined, may deposit a missive supposedly to save millions of dollars by installing a gadget on the production line.

The time and effort expended by the company in this direction often have not been catalogued sufficiently in terms of dollars and cents to discourage the continuation of this costly system. If cost figures were more apparent, the astounding revelation would pale many an executive who, after recovering from the statistics, would boot the system out.

Large plants in other businesses, having been in operation longer than the young reinforced plastics industry, may have perfected the suggestion system, having money to lay out to cover someone's time to direct it properly. Actually, this "someone" most likely would have an assistant or two, plus a secretary, to wade through the suggestions after they have been collected by another person, departmentalize them, assort them, record them, read them, edit and select the more intelligent ones, interview the writer, get the facts into a coherent form, present it to an "unbiased" committee, record the votes in favor of the winner, notify the winner, arrange for the presentation of the award, make public announcements of it in the plant through bulletin boards and plant newspaper, arrange for possible photographs showing the beaming award recipient, and so forth down the line. It is a time-consuming chain reaction accelerated initially by a box with the printed word, "Suggestions."

Now how does this apply to the small plant? Few reinforced plastics molders actually have the money to hire "someone" to generate this kind of activity. Usually, it is a chore issued to the personnel officer or to the advertising and public relations department, if the small plant has such a luxury. Right there it starts cutting into someone's time, and the chain reaction begins on a smaller scale than in a large plant, but certainly more expensive proportionately because the over-all profit picture for the little fellow is leaner.

In a small plant, as with a large one, we realize that the contents of the suggestion boxes have to be audited. Because there should be no discrimination, the inarticulate employee whose suggestion is laboriously written and undoubtedly difficult to read might have a germ of an idea, his suggestion should be given the same attention afforded a more legible presentation. But it does not stop there. If you're going to do this at all well, you have to do it thoroughly from start to finish. Now someone must be assigned to interview the employee and obtain a clearer picture of his suggestion. This "clearer picture" is submitted again probably typed up this time by the personnel department's secretary.

If sketches of the proposed suggestion are pertinent to the idea, more time is involved in getting them drawn. Assuming that after all the work and time involved, the idea has some merit, it often takes a master

*(Continued on page 657)*

*Edited by:*
ERNEST J. CSASZAR, *Sales Manager*
*Newark Die Hobbing & Casting Co.*
*Newark, N.J.*

# Moldmaking & Tooling

## Valve-Gate Mold Design

A novel and extremely helpful method of injection mold construction has been made available recently to the plastics industry. This method involves the incorporation of a valve system into the design of the mold to control the flow of plastic material during the molding cycle to greater advantage and economy than by many presently-used procedures.

This technique is called "Valve Gating,"* and Columbus Plastic Products Co. holds the patents on the design. The patented design and technical data are available to interested users through execution of the proper licensing agreements. The W. R. Grace & Co. is acting as agent in the sub-licensing of this patented valve gating technique.

In quickly describing this type of mold design, we might liken it to a typical hot runner application with the addition of a positive valve shut-off in place of the conventional nozzle orifices. This added feature takes over material flow-control mechanically, rather than the present methods of critical temperature, pressure, and nozzle design relationship, with the ever-present danger of gate freeze-up.

Further, being able to open and shut the gate mechanically at the most advantageous times in the molding cycle offers advantages in the elimination of piston-dwell and pre-positioning. This allows for pre-compression of the molding compound to take place during the entire cure time of the part being molded, thus reducing the over-all cycle and increasing the plasticising efficiency. These, and other features of molding technique involving valve gating can be described more fully to interested parties by the licensing agents. For purposes of this article, my main interest is in the part that valve gating can play in our efforts toward achieving automation in injection molding.

In conventional injection molding we have two basic elements molded. These are the parts and the runner systems. Both of these elements are to be discharged from the mold during the molding cycle. In many cases, the molded parts do not present as great a problem for ejection as does the runner system. There are a number of reasons for this. First, the runner systems are usually large and structurally-weak affairs covering a major portion of the mold area. Although they are positively "knocked-out," they may become joined between K/O pins or other mold details in falling if they hang up, even slightly, at any one point. Secondly, the runners, because of their function and position in the mold, cannot be cooled to the extent that are the molded parts. This allows them to distort when the mold opens, again causing them to possibly hang-up. Since valve gating eliminates runners, we are eliminating runner ejection as one of our stumbling blocks on the road to automation.

It is true that hot runner molds, as such, do not give us runners to eject from the mold. There is, however, the problem of the nozzle orifices. In some instances, the orifices in the nozzles freeze-up. The orifice design, as well as pressure, temperature and other cycle relationships, all have to be adjusted carefully to prevent this objectionable condition from occurring. These relationships often are so critical that the slightest change in the molding cycle will upset the ideal conditions and result in a freeze-up. Here, again, valve gating offers an answer to this problem inthe gate opening and shut-off are controlled positively and mechanically.

(*Continued on page 657*)

*Plastics Technology, 4, 4, 152 (Feb. 1958)

# PLASTICS TECHNOLOGY

## EXPLORING FABRICATION TECHNIQUES

By: L. J. ZUKOR, *Engineering Editor*

### This Issue . . .

. . . marks the initiation of this column. As its name implies, it will endeavor to bring to the attention of the reader some of the universal techniques in the field of plastics processing.

The column will welcome letters from its readers who wish to obtain answers to problems occurring in molding, extruding, calendering, surface treatment, and applications of automation. We will print only those questions submitted in the form of an open letter. All other questions will be answered by confidential mail, and those who wish to remain anonymous, will have their wish respected.

•

### A Large Manufacturer of Blow Molded Products

. . . the Plax Corp., Hartford, Conn., uses (as one method) an ingenious process to fabricate large size, heavy-sectioned bottles with threaded necks. This method employs an automatic machine; the head portion injection molds a tube with the neck section complete, as it will be in the finished product. The neck section is chilled immediately to set its form while the rest of the extrusion still remains plastic. The extrusion then is transferred to another mold for blowing. The transfer operation is performed smoothly and automatically on an indexing mechanism within the machine, after which the extrusion is clamped into the second mold where blowing gives it its final shape.

### A High Fidelity Record Manufacturer

. . . wants to know how to control void formation under his record labels. Due to this situation, his rejects often run as high as 40%. He further stipulates that the labels are included as inserts in the molding press along with the vinyl molding compound.

He has described his operation in the following manner:

a label is placed face down on the lower platen,
a measured quantity of finely-divided vinyl compound is put into the press,
a second label is placed on the upper platen,
the press is closed for the molding cycle.

It is assumed that the manufacturer has experienced no difficulty with his molding compound; therefore, a first thought is that the separation is caused by the outgassing of some volatile material used in the printing of the labels, or by moisture contained in the paper stock. In either case, volatilized gas, steam, or a combination of both, could be the culprit. A suggested solution to alleviate this condition would be for the manufacturer to preheat his label stock to drive off moisture and any residually-entrapped solvent. This could be accomplished in a tray-type, controlled-heat, vented oven. He could then store these labels in a dessicant equipped container until ready for use.

### How To Increase Extruder Output And Improve Quality

To summarize the machine conditions for polyethylene by which extruder output and quality can be improved, output within limits may be increased by

increasing the screw speed;
increasing the screw temperature;
increasing the barrel temperature;
increasing the die temperature; and
decreasing the screen pack (that is, screen mesh or number of screen elements).

There is, however, an optimum range for each of these conditions, beyond which the output can no longer be increased significantly and some essential resin properties may begin to decline.

Quality generally improves with

increasing barrel temperature;
increasing barrel pressure; and
decreasing screw temperature.

Where higher melt temperatures are required (e.g., in flat film operations and in paper, wire and cable coating), quality may be improved by increasing the pressure in the cylinder by the aforementioned measures.

Where low melt temperatures are preferable (e.g., in blown-film and pipe extrusion), quality may be improved by increasing the screw cooling.

This last paragraph has been excerpted from an about-to-be-published book compiled for the plastics industry by the U. S. Industrial Chemicals Co.

—THE END

**New Styrene for Plastics Lighting Fixtures**

*(Cont'd. from page 643)*

caused by actual exposure by approximately 50 times, but also is specific for testing material for fluorescent light applications. Figure 3 shows some agreement between actual exposure and several common tests when stabilizing systems used in Lustrex "perma tone" styrene are evaluated.

A number of stabilizing systems that differ chemically do not provide the same degree of agreement. This highlights the importance of establishing a relationship between actual exposure and accelerated aging effects before accepting short-term testing as being applicable.

## Perma Tone Stabilized Styrene

Having discussed the details of the test methods used in developing light-stable styrene, we can describe the actual performance of the material developed using the aforementioned tests.

Specimens of Lustrex "perma tone" stabilized styrene were subjected continuously to the radiation of a Standard Cool White Lamp battery at a distance of 1.5-inches lamp-to-plastic for 10,200 hours. This exposure is equivalent to 5.0 years operation at 40 hours per week. An increase in yellowness of 12.5 units calculated by ASTM formula was obtained as compared to 27.7 units increase in unstabilized styrene (see Figure 4). An increase of 15 units of yellowness is the industry standard of interchangeability of exposed and unexposed fixtures.

If the distance of the lamps to the plastic is increased, the service life will be increased as shown in Figure 1. Based on this testing, it is believed that Lustrex "perma tone" styrene will extend the service life of a lighting fixture by two to three times when compared to a fixture molded of unstabilized styrene and used under the same conditions.

Having no adverse affects on the physical properties of the base polymer, the additive used has a low color level that provides excellent clarity in "perma tone" crystal formulations. It also permits easy formulation of translucent white and other difficult colors. Compatible with all base polymers, it already is being used to tailor a series of color stable materials with properties ranging from soft flow to high heat resistance for even the most difficult injection molding and profile extrusion jobs.

Lustrex "perma tone" and styrenes like it are certain to abet the trend to greater application of plastics in both residential and commercial lighting.

—THE END

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**Engineering Aspects of Polystyrene**

*(Cont'd. from page 651)*

cause cracking. Shock-resistant materials can be used with inserts without difficulty because of their high elongations. The minimum safe elongation is about 5-6%. Care should be exercised to avoid sharp-cornered inserts that will result in stress concentrations.

Sink marks, bosses, ribs, fillets, wall thickness, weld lines, and inserts are common problems in the design of injection molded parts. The design principles discussed here have been found helpful in producing good designs for injection molding.

—THE END

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**Molding & Tooling**

*(Cont'd. from page 655)*

Although the number of valve-gated molds constructed to date are relatively few, a good number of molders have become licensed. Existing molds can be converted readily to the valve-gate design, offering a very good way to compare the advantages of valve gating with the conditions of molding previous to the change.

A number of mold shops, Newark Die among them, also have been licensed to perform the work of conversion and construction of new valve-gated molds. From the point of view of a greater degree of automation, as well as other advantages, "valve gating" seems like an item well worth looking into.

—THE END

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**Reinforced Plastics**

*(Cont'd. from page 654)*

of tact to select it over the other entrants submitted simultaneously.

Being only human, the losers become disgruntled. In their eyes, their suggestions were better. After frequent tries and not winning, some develop thoughts that the system is "fixed."

In addition to the ill will, hurt feelings, and the like that plague the suggestion system, there is the additional consideration of keeping accurate records, checking new ideas currently presented with those made last year by someone else, settling disputes, and determining fair payments. All in all the problems and dangers are many and, when the costs are considered, they overshadow the benefits realized, in my opinion, particularly for small operations.

—THE END

Global Survival Kit, opened to show oxygen supply, radio, and other items, is molded of glass-reinforced Parapley polyester resin, a product of Rohm & Haas Co.

# Plexiglas Murals at Polytech

Plexiglas murals at Brooklyn Polytechnic Institute.

A new technique in mural design has been developed by a New York muralist, Abraham Joel Tobias, in cooperation with Rohm & Haas Co. Based on the passage of light through multiple colors and layers of Plexiglas acrylic sheeting, the technique eliminates, among other things, the tiresome and costly process of leading employed in stained glass windows. Solvent cementing is all that is required to join the myriads of precision-cut shapes.

The two murals shown in the accompanying illustration have been installed at Brooklyn Polytechnic Institute. Each mural is 10 feet tall by three feet wide, and required approximately 3,500 pieces of Plexiglas in 58 different colors and shades. Three- by 10-foot transparent acrylic sheets, ¼-inch thick, were overlaid with transparent colored pieces shaped by Mr. Tobias. Edge-cemented, they were built up to as many as six layers to create three-dimensional effects and subtle variations in color.

The panels are framed in aluminum and covered on each side by a transparent acrylic shield. The shields are sealed to the edges of the frames, thus protecting the murals from dirt and scratches. In this particular application, duplicate designs were built up on each side of the base sheets so that they might function both as interior and exterior architectural art.

This new art medium is expected to open up new vistas of architectural design. Light weight and strong, they can be worked with a minimum of effort, The only complexity is the design itself. Science is not only the theme of these particular murals, but also its source.

—THE END

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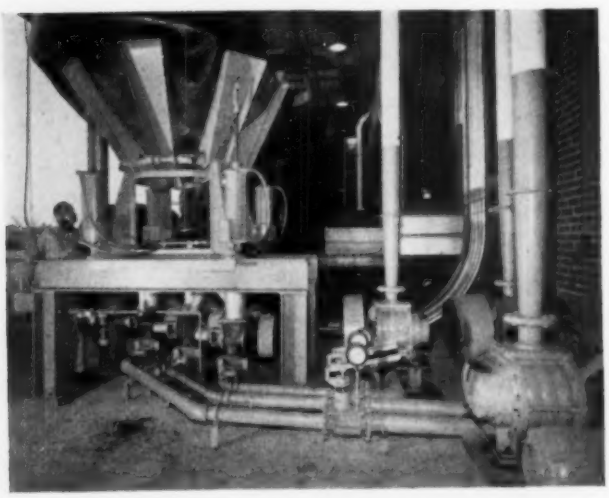
**High-Speed Pneumatic Conveyor System**

*(Cont'd. from page 652)*

folds suspended above the extruders. The top section of each manifold serves as a cyclone separator, dropping polyethylene into a tank and discharging conveying air through a roof vent. Gravity drops lead to the machine hopper, and flow is controlled by the operator.

Each conveyor line has an automatically-controlled blower which introduced filtered air at 250 cubic feet per minute. Polyethylene granule speeds approach 5,000 feet per minute, and pressures within the system range from 2½-7 psi. A rotary feeder discharges the pellets into an injector which, in turn, feeds the material into the line. Three-inch aluminum tubing with 0.065-inch wall thicknesses form the actual ducting.



Polyethylene leaves the neoprene Sealdbins via flexible sleeves to the Dracco feeders.

Insulating conveyors are fed from 11 supply stations, each consisting of a cradle stand which adjusts to the collapsing Sealdbin. Each station is connected to a separate conveyor, and a 12th conveyor connects to all stations, permitting it to furnish any of the 11 colors to the two machines it serves. The other 11 conveyors supply 11 colors through 11 distribution manifolds. There are 62 gravity drops to the 42 insulating extruders, thus affording flexibility. To prevent intermixing of colors, the conveyor lines are purged by the aforementioned blowers which start 30 seconds before the feeders, stop 30 seconds after the feeders stop.

Sheathing conveyors are fed from two supply stations, which distribute black polyethylene to the eight extruders via distribution manifolds. When required hot air from a cable-drying oven is injected into the system to eliminate any moisture problems. The present system employs five conveyors, and provision has been made for a sixth should production warrant.

The entire system is controlled by one man at a central control panel. Indicating lights enable him to determine the status of each conveyor at a glance, and it is estimated that he can receive, unload, store, and deliver up to 100,000 pounds of material during a work day.

—THE END

# News of the Societies

## SPE New York Section

The May 21st meeting of SPE's New York section drew a record turn-out, with more than 250 members and guests crowding in the Hotel Governor Clinton's banquet hall. Three professional activities groups were represented including the newly-formed vinyl sub-group which, by itself, drew 150 members.

The reinforced plastics group witnessed a panel discussion on mold making. Moderator for the session was A. Harvey Johnson, Verly Plastics Co. Participants included S. Fialkoff, Camin Laboratories, Inc., Richard T. O'Connor, Devcon Corp., and John A. Kavanagh, Standard Tool Co.

Mr. Failkoff discussed "Molding Making by Electroforming." With this process, precisely dimensioned, highly polished cavities can be made under conditions where other methods fail. The process is essentially the same as electro-plating except that larger depositions of metal are required which, when removed from the mandrel, will form a self-supporting part or mold. One of the advantages of this method is that the surface finish of the mandrel is exactly reproduced in the cavity, thus eliminating expensive interior finishing operations.

"Devcon C—An Epoxy for Low-Cost Molds" was the subject of Mr. O'Conner's discussion. This material was shown to be satisfactory for short runs, since it can be made at a low cost for both material and labor. Devcon C weighs approximately 0.0645 pounds per cubic inch, and has a compression strength of 15,000 psi. at 350° F. Readily machinable with regular tools, the material exhibits good heat resistance permitting continuous operating temperatures up to 400° F., with intermittent operation as high as 500°.

Speaking on the "Shaw Process for Building Molds" Mr. Kavanagh stated that this is the first major development that makes it possible to produce cheaper molds for those applications calling for an intricate cavity and core with reasonable tolerances. The best results currently are obtained in casting beryllium copper parts directly from models which can be made from any material. Approximately 99% of the detail can be reproduced in the cavity. Steel hobs also can be cast at a substantial saving; and these hobs in turn used to cast beryllium copper cavities and cores.

The first vinyl sub-group meeting was introduced by A. R. Miller, Ideal Toy Corp., who served as moderator and gave a short discussion pointing out the necessity of adding heat and light degradation inhibitors to chlorinated polymers such as PVC.

Gerry P. Mack, M & T Laboratories, Inc., discussed "History and Development of Organo-tin Stabilizers" briefly reviewing their synthesis and chemical structure. He pointed out that this group of tetra valent stabilizers can be custom made to fit specific applications. Concluding his talk with an outline of new developments in this field, Mr. Mack announced a new group of vinyl tins that can be copolymerized with vinyl monomers to give built-in stabilization.

"Barium-Cadmium Stabilizers" were explained by Charles F. Fuchsman, Ferro Chemical Corp., who emphasized the importance of synergism in their formulation. Important auxiliary stabilizers were shown to be chelators, zinc, and epoxy compounds. By careful control of heat and light stabilization, interesting photosensitive vinyl systems can be developed.

Abb L. Scarbrough, National Lead Co., spoke on "Lead Stabilization of Vinyl Resins." He stated that the lead stabilizers which were used to fill an emergency need in the first days of commercial vinyl processing, were litharge and basic carbonate of white lead. These soon were improved with specialized lead salts, such as the silicates and sulfates. Further research on the theory of degradation and stabilization led to the modern, tailored, lead organic and inorganic salts which today provide precise and powerful stabilization.

The thermo-forming sub-group was addressed by E. Bowman Stratton, Auto-Vac Co., whose topic was "A Survey of New Equipment, Materials, and Techniques for the Forming Industry." Mr. Statton discussed new materials for transparent packaging from the price and physical property point of view, covering the oriented, high density polyethylenes, Mylar, Kralastic, Polyflex, and butyrate. He outlined the production phases of pressure forming with special emphasis on product cost and speed of production. Also covered was air cushioned plug forming and its relation to materials, equipment, and production techniques.

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## MCA Holds Annual Meeting

Members of the Manufacturing Chemists' Association, Inc., Washington, D. C., gathered June 12-14 at The Greenbrier, White Sulphur Springs, W. Va., to attend that organization's 86th annual meeting. Of 169 member companies, 138 were represented, while personal attendance totaled 763. Activities taking place included the annual report by MCA president, General John E. Hull, U.S.A. (ret.); election of officers; and presentation of the Lammot du Pont Safety Awards.

Reporting on significant developments during the past year, Gen. Hull stated that the organization sponsored the formation of committees on plastics, reactive metals, chemical industry insurance, and chemical nomenclature.

Headed by architect William Demarest, the plastics committee has initiated a program to promote the acceptance of plastics in building. Its first efforts have been toward the revision of certain building codes to permit greater use of plastics materials. The committee operates in conjunction with the Society of the Plastics Industry, Inc., and to date the combined operation has conducted investigations in flammability testing; promoted liaison with fire protection authorities; and has established an educational program to help builders make the most effective use of plastics products. MCA also maintains a research project at Massachusetts Institute of Technology, where recent developments have produced newer testing apparatus and techniques to determine the mechanical properties of plastics.

Lammot du Pont Safety Awards, given annually to those chemical firms showing greatest improvement in plant safety over a five year period, were presented by Ernest Hart, Food Machinery and Chemical Corp. Bronze plaques representing first prize went to U. S. Rubber Co.'s Naugatuck Div., for working more than 2-million man-hours per year with a 59% decrease in accident frequency. First prize in the second category, for firms working less than 2-million man-hours per year, was awarded to Royce Chemical Co., and the Tennessee Corp., both of whom had achieved a 100% reduction in accident frequency.

Association officers elected include: Harry B. McClure, Union Carbide Corp., chairman, board of directors; John T. O'Connor, chairman, executive committee; Gen. John E. Hull, president; D. S. Frederick, Rohm & Haas Co., and Fred C. Foy, Koppers Co., Inc., vice-presidents; and M. F. Crass, Jr., secretary-treasurer. Directors elected for terms varying from one to three years were: R. L. Cunningham, Ohio Ferro-Alloys Corp.; J. Robert Fisher, Gamma Chemical Corp.; Joseph Fistere, Mallinckrodt Chemical Works; Marlin G. Geiger, W. R. Grace & Co.; W. G. Malcom, American Cyanamid Co.; R. C. McCurdy, Shell Chemical Corp.; Glenn B. Miller, Allied Chemical Corp.; Charles S. Munson, Air Reduction Co., Inc.; Hans Stauffer, Stauffer Chemical Co.; James C. White, Tennessee Eastman Co.; John L. Gillis, Monsanto Chemical Co.; Raymond F. Evans, Diamond Alkali Co.; and S. B. Penick, Jr., S. B. Penick & Co.

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## SPE Regional Conference

A regional technical conference, sponsored by the Chicago section of the Society of Plastics Engineers, Inc., Greenwich, Conn., was held April 18 at the Conrad Hilton Hotel, Chicago, Ill. The program, entitled "New Techniques in Injection Molding," featured the presentation of four papers and was concluded with a panel discussion.

# News of the Industry

## Polymer Corp. Purchases Halex

The entire outstanding capital stock of Halex Corp., Detroit, Mich., has been purchased by Polymer Corp., Reading, Pa. Halex has been producing pressed and sintered parts from Nylasint, a Polymer product, and will expand its operations along those lines as a Polymer division. Present management will be retained.

## Reed Expands Facilities

Approximately 11,000 feet of added manufacturing space have been acquired by Reed Plastics Corp., Worcester, Mass. The third major expansion in the firm's 10 years of existence, it will enable Reed to produce more modified polystyrene and polyethylene color blends. This brings the total space available up to 50,000 square feet of plant area.

## Midland-Ross Acquires Hartig

Midland-Ross Corp., formed last year by the merger of Midland Steel Products Co. and J. O. Ross Engineering Corp., has purchased Hartig Engine & Machine Co., Mountainside, N. J., a manufacturer of plastics extruders. Edward Greene, president of Hartig and principal shareholder, will continue as operating head of the firm, which will become a division of Midland-Ross. The purchase reflects M-R's long-range growth plans aimed at broadening the company's fields of operations.

## Forms Plastic Piping Company

A new firm, Plastitrol, has been formed as a southern California distributor of plastic piping. Located at 1974 Charle St., Costa Mesa, Calif., the company will stock brand-name piping items of PVC, Kralastic, polyethylene, Penton, Pro-Fax, styrene, Teflon, Kel-F., and others. Manager for the firm is Newton Crum.

## Adams Fibreglass Co. Formed

A plastics consulting and manufacturing firm has been formed in Wilmington, Calif., under the corporate name, Adams Fibreglass Co. The company already is producing special enclosures for use on digital computers which are used in launching Atlas missiles, and is tooling for the production of aircraft components.

For the electronics industry, Adams will offer consultation and manufacturing services on developmental projects. Production of corrosion-resistant surfaces also is included in the manufacturing service.

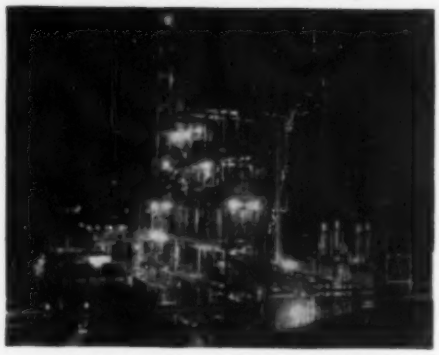
## Technical Assistance

A technical assistance program, designed to improve installer's handling techniques in the use of Styrofoam insulating materials, has been launched by Dow Chemical Co., Midland, Mich. Known as the Approved Contractor Plan, Dow officials expect the program to fill the need for closer company-contractor relationships which have been necessitated through the growing acceptance of expanded polystyrene insulating materials.

Under the agreement, approximately 50 insulation contractors throughout the country are receiving technical assistance and merchandising aids, in addition to the company's identifying "Mark of Approval." In return, the contractor agrees to install Styrofoam according to Dow's recommendations, and to correct any installations which fail within two years due to faulty workmanship.

## Appleton Purchases Doven

Appleton Machine Co., Appleton, Wis., has acquired Doven Machine & Engineering, Inc., Chicago, Ill., and will move the plant to its Wisconsin site. There, it will be operated as the Doven Division under the direction of Eugene Doven as vice president. The newly-purchased firm manufactures slitting and rewinding equipment for the plastic industry. The move should enable Appleton to expand its line and enter the fields of paper converting, packaging, plastic insulation, and textiles.



PICCO's new resin-solvent facility

## PICCO Erects New Facilities

A hydrocarbon resin- and aromatic solvent-producing facility has been placed on stream at West Elizabeth, Pa., by Pennsylvania Industrial Chemical Corp. The new plant supplements the firm's other units at Clairton and Chester, Pa. Highly-automated, it features many unique manufacturing techniques and controls. The plant is located on the Monongahela River, therefore, shipments can be made by barge as well as by truck or rail.

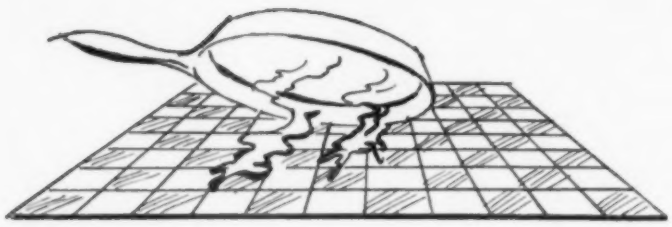
## Toy Design Winners Announced

Special awards totaling $5,000 were contributed to four camps for handicapped children in the name of five toy molders who won first prize in the annual plastics design competition sponsored by Koppers Co., Inc., Pittsburgh, Pa. First prize winners included: Vanguard Toy Co., Buffalo, N. Y.; Mattel, Inc., Los Angeles Calif.; Cosom Industries, Minneapolis, Minn.; Knickerbocker Plastic Co., Inc., North Hollywood, Calif.; and Fisher-Price Toys, Inc., East Aurora, N. Y.

Both Vanguard and Fisher-Price selected Cradle Beach Camp, Angola, N. Y., as recipient for their prize money; Camp Paivika, Crestline, Calif., received Mattel Inc.'s award; Cosom Industries named Camp Courage, Maple Lake, Minn.; and Camp Max Straus, Glendale, Calif., received the Knickerbocker Plastics prize. First of Koppers' annual design competitions to be designated for toys, the contest drew nearly 400 entries from some 112 toy manufacturers located throughout the United States.

## German Plastics Digest

Publishers of the German plastics journal, Kunststoffe, have announced the addition of an English language supplement which will make its debut in the July 1958 issue. Entitled "German Plastics Digest," the section will contain translations of the most important articles appearing each month. Annual subscription price is $32.00, for U. S. readers; payable to Carl Hanser, Zeitschriftenverlag GMBH, Munich 27, Germany.



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## Dayton Opens Research Labs

Latest in a series of expansions by Dayton Rubber Co., the Freedlander Research & Development Laboratories were opened officially in mid-April. The 25,000 square-foot, two-story structure is located adjoining American Latex Products Corp., a wholly-owned Dayton subsidiary.

The labs are reportedly the most complete facilities erected by a product manufacturer for basic research and product development of urethane materials. They also contain facilities for quality control investigations, organic analysis, and prototype fabrication. Also housed are a library, testing facilities and offices for engineers and technical personnel. The research center was named after A. L. Freedlander, chairman of the board for Dayton Rubber.

## Boost Production Capacity

Construction of a new wing at Bethlehem plant should add about 50% to the productive capacity of Sarco Mfg. Corp., and its allied firm, Sarco Co., Inc. The one-story plant will be devoted exclusively to the manufacture of Sarco Thermo-Dynamic steam traps; and will house a battery of automatic lathes induction heating machines, grinders, drill and punch presses, degreasers and inspection equipment. There will be a large storage area for stainless steel bar stock, and an electrically-operated overhead crane system for materials handling.

## Reinforced Plastics Housings

Glass-reinforced polyester cabinets and housings are now available from Fischer & Porter Co., Hatboro, Pa. Light, strong, and corrosion-proof, the cabinets can be used for housing components and assemblies for the chemical and allied fields. All colors are available, molded into the plastics itself.

## Continental Completes Plant

Continental Plastics has recently moved into its new plant at 108 N.E. 48th St. Oklahoma City, Okla. The $75,000 building contains 7,500 square feet of manufacturing and office space and is designed to allow for expansion up to four times its present space.

A 25% increase in personnel will be added to cope with special packaging and custom molding problems. Among the plastics items produced by the firm are louvers, handle coverings, boot tips, pump parts, oil pipeline valve plates, baby seats, and pharmaceutical vials.

Narmco's new research laboratories.

## Occupies Research Center

A $500,000 research and development center, located on a 10-acre site at San Diego's Research Park, has been occupied by Narmco, Inc. San Diego Calif. The recently-erected structure is completely equipped with facilities for chemical, physical, and structural testing, as well as for prototype fabrication.

The laboratories are designed to expedite the development of high-strength metallic structures, reinforced plastics and high temperature adhesives. Activities will continue under the supervision of Edward P. Carmichael, director of research and development.

## Offers Plastics Scholarships

Scholarships in plastics, chemistry, textiles, paper, leather, electronics, physics, and allied fields are available at Lowell Technological Institute Lowell, Mass. Available this Fall are 115 scholarships valued at $27,000, plus four fellowships with a total value of $5,100. Freshman can qualify for 25 of the awards.

## Celanese Completes PVA Unit

A PVA emulsion facility has been opened by Celanese Corp. of America, adjoining its plant in Belvidere, N. J. Annual capacity is in excess of 20-million pounds. The firm formerly manufactured the emulsions in Linden, N. J., and will now turn that space over to the production of polyester resins. Although used principally in paints, PVA emulsions are finding large volume applications in adhesives, nonwoven fabrics, textile finishing, and paper coating.

## Cyanamid Sponsors Research

A limited number of senior research scientists at American Cyanamid are being granted up to a year's leave with full pay to undertake research at universities either in this country or abroad. Under the plan, the award recipient retains his active status with the company during his absence, and will receive funds to cover traveling and other expenses. He will work with a professor of his own selection, and will contribute upon request to the university's activities through seminars and lectures.

The program is part of an over-all plan to further the development of qualified senior personnel within Cyanamid, and simultaneously should keep the company up-to-date on research developments. Another Cyanamid plan calls for paying half-salary plus tuition to employes studying for graduate degrees.

## Rockefeller Center Exhibit

A fully automatic injection molding machine, producing one-ounce measuring scoops for the visiting public has been incorporated in the permanent exhibit maintained at Rockefeller Center by American Cyanamid Co., New York, N. Y. The press was made by Van Dorn Iron Works Co.; incorporates a 4-cavity mold; and operates on a 20-second cycle to produce 720 scoops per hour. Upon conclusion of the exhibit, the press will be used for test purposes at Cyanamid's plastics development laboratories currently under construction at Wallingford, Conn.

## Ferro Continues Expansions

Over $500,000 is being spent by Ferro Corp. to expand the firm's Brazilian subsidiary, Ferro Enamel, S. A., Sao Paolo, and the Ferro Fiber Glass Division, located in Nashville, Tenn. The South American firm manufactures porcelain enamel, glaze frit, and color oxides for the ceramic and plastics industries; and seeks to diversify further its line of products.

The Nashville plant recently completed a $1.5-million program, and is reported to be the world's only integrated glass fiber plant capable of producing finished glass textiles from basic raw materials. Expansion here is due to increased demands by the reinforced plastics industry.

## Dow Acquires Extrusion Firm

The common stock of Extruders, Inc., Hawthorne, Calif., has been purchased by Dow Chemical Co. A supplier of polyethylene film to West Coast markets, Extruders will continue to operate as a Dow subsidiary under the same management. The firm presently employs about 80 persons.

Metal & Thermit's butyltin plant at Carrolton.

## Golden Anniversary

Metal & Thermit Corp., New York, N. Y., producer of basic chemicals, heat and light stabilizers, and flame retardants for the plastics industry, celebrates its 50th anniversary this year with the opening of an organo-metallic chemicals plant near Carrolton, Ky. The new facility will produce butyltin compounds through a method described as a modification of the Grignard process.

## Isocyanate Markets To Double

"Isocyanate consumption can be expected to reach 12-million pounds in 1958, and will continue upward into the 40-50 million pound range by 1960," according to Joseph Marzak, manager of market research for Allied Chemical's National Aniline division. "Consumption in 1957 amounted to only slightly over 6-million pounds," he added, pointing out that "future growth lay in the fields of isocyanate-based coatings, potting compounds, adhesives, and textile treatment as well as in injection and compression molding.

"Flexible urethane foams are finding more and more applications in the automotive industry, as well as for bedding and furniture. Urethane coatings on wire and leather should reach 3-million gallons." he predicted.

## Plastics for Big Bertha

Plastic cartridge cases for artillery shells are being produced in field-test quantities by Tube Turns Plastics, Inc., Louisville, Ky., under the terms of a development contract awarded that firm by the Naval Ordnance Laboratory, Silver Spring, Md. The shell cases, designed for the 105-millimeter howitzer, are undergoing actual test firings at the Army's Aberdeen Proving Ground.

Injection molded from Cycolac, a Marbon Chemical product, the shell components are required to withstand instantaneous gas pressures ranging from 6,000-35,000 psi., and flame temperatures up to 4,000° F. The material has stood up so well under these conditions that, during earlier tests, some shells were re-used as many as six times.

If adopted for permanent use in military applications, the Cycolac cartridge's lighter weight will facilitate handling during transportation and at the gun-site. A non-strategic material, the plastic can be produced in almost any color, with cost reductions as great as 25%.

## Information, Please

A reference book entitled "Mechanical Fastening and Machining of Fibrous Glass Reinforced Plastics," is being compiled and edited under the direction of T. B. Blevins, Owens-Corning Fiberglas Corp. Purpose of the project is to make available to industry a compendium of design data that will aid in the use of reinforced plastic as an engineering material.

The editors have extended an open invitation to submit reports, photographs, and other data with the proviso that full credit (company and personal), in addition to a free copy of the book, will be given to everyone contributing useable information. All material should be marked to the attention of: Marshall D. Weiss, Owens-Corning Fiberglas Corp., Reinforced Plastics Laboratories, Ashton, Rhode Island.

## Linear Polyethylene Venture

Commercial production of high density polyethylene containers is being undertaken by Owens-Illinois Glass Co., Toledo, O., whose newly-developed product will be marketed to manufacturers of detergents, waxes, polishes, and related products. Initial output, which will include bottle capacities from 12-32 ounces, will be delivered from the company's Glassboro, N. J. plant.

## Plastics Technology Courses

In cooperation with the Newark section, Society of Plastics Engineers, Inc., three courses in plastics technology are being offered during the 1958 fall term by the Newark College of Engineering, Newark, N. J. Conducted under the supervision of experienced technical and engineering personnel from industry, each course will meet one night a week beginning at 7:00 P.M.

Two courses beginning September 11 are: Process Properties of Plastics; and Extrusion of Plastics. The first includes a history of plastics, classification of material, chemical structure, sources of primary raw materials, properties, and flow characteristics. Extrusion of Plastics will cover flow properties of thermoplastics in extrusion, design and construction of an extruder, maintenance and operation, take-off equipment, die design, and extrusion of monofilaments, film, sheeting, and sections. Both courses include a plant inspection trip.

The third course, entitled Plastic Product Design, will start September 15. Sessions will be devoted to product requirements, material selection, appearance, mechanical and electrical properties, heat and chemical resistance, compatibility, size and aesthetic aspects, parting lines and contours, shrinkage, holes, thread-undercuts, and tolerances.

## Builds Production Facility

A plant for the production of Teflon 100-X is being constructed at Parkersburg, W. Va., by E. I. du Pont de Nemours & Co., Wilmington, Del. Representing an additional expansion to the company's Washington Works location, the unit is scheduled for operation during the middle of 1959.

Production of the FEP fluorocarbon resin will supplement the company's line of TFE resins. Both are highly resistant to chemical attack, and exhibit nearly the same physical, electrical, and thermal properties. The TFE types are used in the manufacture of high-temperature insulation, chemical-resistant hose and tubing, packing, and gaskets. The FEP materials will find initial application as jackets for coaxial and multiconductor cable, aircraft and industrial wiring, flexible and rigid printed circuits, electronic components, tubing, and packaging for corrosive products.

## A Decade of Transistors

Marking the tenth anniversary of the introduction of transistors to the electronics world, Bell Telephone Laboratories, Murray Hill, N. J., opened its doors June 17th to more than 100 members of the industrial and consumer press. The all-day program commenced with a seminar reviewing progress in transistor technology during the past decade; and concluded with a tour of the laboratories.

Semiconductor electronics, as well as transistor applications in the Bell System, commercial, and military fields, were described by Drs. M. J. Kelly, president; W. J. Pietenpol, director of development, semi-conductor devices; and J. P. Molnar, vice president, military development. The laboratory tour included demonstrations of ultra-high-frequency transistor operation; contamination control of semi-conductor components; transmission of pulse code modulation; and other phases of semiconductor research and development.

# Names in the News

Leland M. White

**Leland M. White** has been appointed director of research and development for United States Rubber Co., replacing **Sidney M. Cadwell** who has retired after 39 years of service. Dr. White joined the firm in 1940 as a research chemist, and has served as a group leader, department head, and assistant director of the department.

**Dewey H. Nelson** has been appointed manager of the Becco Chemical division, Food Machinery & Chemical Corp., Buffalo, N. Y. Former assistant divisional manager, he replaces **Frederick A. Gilbert** who has been appointed general manager of FMC's new inorganic chemicals department.

**Earl F. Miller** has been named manager of General Tire & Rubber Co.'s chemical plant in Ashtabula, O. He replaces **P. J. Wallace,** who has been named production manager of the firm's new synthetic rubber plant in Odessa, Tex. Mr. Miller formerly served in the manufacturing analysis department.

James R. Kallaher

**James R. Kallaher** has been appointed to the new post of general sales manager for National Vulcanized Fibre Co. Formerly Chicago district sales manager, he has been with the firm since 1936. Succeeding Mr. Kallaher is **Donald W. Stewart,** who had been Boston district manager. New Manager in Boston is Ralph E. Bryant.

**Harold A. Swanson** has been elected vice president and to the board of directors of Nopco Chemical Co., Harrison, N.J. Mr. Swanson is in charge of sales and laboratories for the firm's industrial and fine chemical divisions.

**Mario J. Petretti,** former vice president in charge of engineering for Camfield Fiberglass Plastics Corp., has joined Product Techniques, Inc., Hudson O. as vice president in charge of Midwestern sales. He will maintain headquarters in Grand Haven Mich.

**Harold B. Wright** has been named to the new post of Royalite commercial products sales manager at the Chicago plant of U. S. Rubber Co. He joined the firm's footware and general products division in 1951.

John F. Bergin

**John F. Bergin** has been elected a vice president of Rohm & Haas Co., Philadelphia, Pa. He had headed the company's patent department for many years, and was elected an assistant secretary in 1948.

**J. Philip Smith,** general manager of Chas. Pfizer & Co.'s chemical sales division, has been elected to the firm's board of directors. He joined the company in 1933 as a production man in the organic acid department.

**F. J. Seider** has been appointed manager of general services for Union Carbide Chemicals Co. **J. N. Falkinburg** replaces him as manager of the general sales office, and **J. M. Sartorius** and **J. P. Galaba** have been named assistant managers.

Robert Cooney

Samuel Zuckerman

**Samuel Zuckerman,** plant superintendent in Brooklyn for H. Kohnstamm & Co., Inc., has been elected vice president of the firm. Dr. Zuckerman joined the firm in 1936 as a chemist and has worked in control, production, sales service, and research. He became technical director of the organic color division in 1950 and plant superintendent in 1954. **Robert Cooney** has been appointed assistant vice president, a promotion from research supervisor. Dr. Cooney joined Kohnstamm in 1934 as a research chemist, and has served as a group leader.

**David S. Chatterton** has joined the chemical engineering staff of General Mills Central Research Laboratories, Minneapolis, Minn.

**Herbert W. Mason, Jr.,** has returned to Reichhold Chemicals Inc., as administrative vice president after a year's leave of absence. He first joined the firm in 1936.

**Charles A. Lindsay** has been elected vice president and general manager of Stauffer Chemical Co.'s molded products division. He joined the firm in 1943 as plant manager.

**Edward J. Babis** has been elected executive vice president and general manager of American Molding Powder & Chemical Corp. He formerly served as credit manager and administrative assistant to the general manager.

**Gerritt V. Lydecker** has been named a molding materials technical sales representative for Bakelite Co. From headquarters in Detroit, he will cover the Eastern Michigan area.

**Thomas L. Denney** has been named general sales manager for Garlock Packing Co., Palmyra, N. Y. He previously served as special assistant to the marketing vice president, **J. B. Sewell.**

**W. L. Vega** has been elected vice president in charge of sales and advertising for American Plastics Co., a subsidiary of Heyden Newport Chemical Corp. He has served in all phases of plastics fabrication from film sealing to reinforced plastics molding, and for the last two years has been the firm's general sales manager.

**Rene Durr** former manager of technical service at the Elizabeth, N. J., plant, has been named Western region manager of Reichhold Chemicals' emulsion division. Other appointments within the division include Arthur Gronet and John Bress as technical service representatives in Argo Ill., and Azusa, Calif., respectively.

Kenneth Perkins

Franklin A. Park

**Kenneth Perkins, Franklin A. Park, Howard T. Peters,** and **Lloyd E. Raymond** have been appointed senior process engineers on the production staff of Singer Mfg. Co., New York City. They will be responsible for investigating new materials, processed, and techniques. Mr. Perkins will be concerned with plastics and adhesives and Mr. Park will concentrate on foundry practices and shell molding.

**W. F. Munnikhuysen** has retired as chairman of the board of Koppers Co. Inc., a position he has held since 1955. He will remain a member of the board and a consultant to the company. **Fred C. Foy** has been elected to his former position. Mr. Foy was elected president in 1955.

**Jack Rebman** has been appointed director of the newly-created research and experimental department of Revell, Inc., Venice, Calif. He is a former design specialist with Lockheed Aircraft Co. and was manager of product engineering for Lord Mfg. Co.

**Henry K. Chi** has joined the research department of Monsanto Chemical Co.'s plastics division at Springfield, Mass. He was formerly employed by Ray-O-Vac.

Alex Mann

**Alex Mann** has been appointed sales manager of vinyl bookbinding materials for General Tire & Rubber Co.'s Reshro division, Cranston, R. I. He will continue as product manager for Respro materials used in the handbag and novelty fields. Distributor for the Respro line is Sommers Plastic Products Co., of New York City.

**Arthur M. Pounds** has been appointed supervisor of new product development at B. F. Goodrich Chemical Co.'s development center at Avon Lake, O. He joined the firm in 1948 as a junior development engineer, and has held various assignments in polymer development. He later became development engineer and senior technical man.

**William W. Tobin** has been appointed technical sales representative for Geigy Industrial Chemicals, Ardsley, N.Y. A former New England salesman, he will represent the firm in the metropolitan New York area.

**Lewis W. Lubenow** has been named sales manager for the semi-bulk handling department of Delta Tank Mfg. Co.'s materials handling equipment division.

**Arthur Larson** has been named a sales representative for Tee-Pak, Inc., covering the State of Illinois. He formerly served with Standard Oil Co. of Indiana.

Andrew J. Paucek

**Andrew J. Paucek** has been appointed to the newly-created position of manager for the plastics-assembly and mica-manufacturing plant of Sylvania Electric Products, Inc., located in Titusville, Pa. He joined the firm in 1950 as supervisor of quality control and has been serving as manufacturing superintendent in Titusville.

**James C. Fish** has been appointed market development representative by Du Pont's fabrics division. He will be concerned with industrial applications for Armalon TFE-fluorocarbon felts.

**John E. Kiel** and **Stanley J. Thorsten** have been named packaging films representatives in Chicago and Atlanta, respectively, for Goodyear Tire & Rubber Co.'s films & flooring division.

**John H. Foley** will represent the plastics division of Reynolds Metals Co., in the Southeast. He will be responsible for sales of polyvinyl alcohol film and PVC film from southern New Jersey to Florida, and will maintain headquarters in Camden, N.J.

**Fred J. Stross,** a research supervisor in Shell Development Co.'s Emeryville (Calif.) Research Center, has accepted chairmanship of a newly-formed group in the National Research Council—Subcommittee of Definitions and Units and Modes of Publication in Gas Chromatography. This group will operate within the Analytical Chemistry Committee of the Council's Division of Chemistry and Chemical Technology.

W. Mel Taylor

**W. Mel Taylor** has joined F. J. Stokes Corp. as assistant to the vice president in charge of sales and marketing. For the past three years, he reorganized Reo Motors' distribution operations and served as the firm's Eastern regional manager. He also had served as vice president and director with Autocar Co.

**James E. Skrna** and **John G. Senese** have been appointed sales engineers for the plastics division of Dayton Rubber Co. They will cover the Midwest and Eastern territories, respectively.

**Edward Kodys** has been appointed works manager, molded articles division, for Foster Grant Co., Inc. Leominster Mass. Other appointments included Jack Berger as assistant works manager and **Bernard McDowell** as plant superintendent.

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**Robert M. Ulmer** has been appointed assistant general sales manager of Armstrong Cork Co.'s glass & closure division. He is succeeded as manager of glass container sales administration by **Byron T. Petry.**

**Nat C. Robertson** has been elected vice president in charge of research & development for Spencer Chemical Co. He previously served in the same capacity with Escambia Chemical Co. **O. V. Luke** has been named director of central research. He formerly served as director of research for Celanese Corp. of America.

**Lewis C. Pape** has been named general sales manager for Dayton Rubber Co.'s foam division. Former general sales manager for American Latex Products, Mr. Pape will direct activities from headquarters in Asheville, N.C.

**Arthur G. Pinard** has been appointed manager of industrial products department, Canadian Resins & Chemicals, Ltd., Montreal Que. He previously served as sales supervisor for resin and chemical products. **Edward A. Clout** former sales supervisor for granular products, has been named supervisor for the calendered materials division.

**Donald D. Pascal** has been elected president and chief administrative officer of National Starch Products, Inc. Formerly executive vice president, he replaces **Frank Greenwall** who has been elected chairman of the board and chief executive officer. **James Dillon** has been elected senior vice president, and will be responsible for exploring and developing new fields of company activity.

**R. G. Luskin** has been appointed West Coast district manager for Goodyear Tire & Rubber Co.'s chemical division. From headquarters in Los Angeles, he will direct activities of the Los Angeles, San Francisco, and Portland offices. Prior to this assignment Mr. Luskin was a special representative in the Southwest.

Mol-Rez Division, American Petrochemical Corp., has appointed Meyer Materials, Indianapolis, Ind., and Thompson Hayward Chemical Co., Kansas City, Mo., as sales representatives for its Pleogen polyester resins. Branches of the latter firm and the respective managers are as follows: Dallas, Tex., **F. W. Ruffi;** Denver, Colo., **K. K. Dunham;** Houston, Tex., **Clark Miller;** Little Rock, Ark., **R. F. Wagner;** Lubbock, Tex., **Bill Swart;** Memphis, Tenn., **E. F. Bouldin;** New Orleans, La., **R. C. Allen;** Oklahoma City, Okla., **C. L. Helbing;** Omaha, Nebr., **Max Mason;** San Antonio, Tex., **Fred Wright;** Shreveport, La., **William Lonnecker;** St. Louis, Mo., **Morton Meyer;** Tulsa, Okla., **G. F. Harrington;** Wichita, Kans., **C. F. Potts;** and Kansas City Mo., **F. M. Goodwin.**

Richard Rouviere

**Richard Rouviere** has been appointed to the newly-created position of regional sales manager for Devcon Corp., in the Northeastern states and Canada. He formerly served as market extension engineer for all of the United States and Canada.

**Edmond S. Bauer** has been named an associate in Monsanto Chemical Co.'s plastics division development department. Since 1955, he had been serving as assistant director of sales for resin products. **Samuel C. Finnell, Jr.,** has been appointed director of marketing for the company's overseas division. His former title was director of plastics sales. **Richard D. Sullivan** replaces Mr. Finnell.

**Philip J. Rodgers** has been appointed a technical representative for Claremont Pigment Dispersion Corp. He will service gravure and flexographic printers, as well as vinyl compounders in the New York Metropolitan area.

**Donald L. McCuen** has joined the industrial chemicals division of Pittsburgh Coke & Chemical Co., as sales representative. Working the Philadelphia territory, he succeeds **Walter H. Daub,** who returns to Pittsburgh with the product development section.

**E. J. Tolle** has joined Instron Engineering Corp., as sales manager. He formerly served as sales education and training manager for General Aniline & Film's Ozalid division. **Robert O. Smith** has joined the firm in the capacity of production manager. Mr. Smith had been a management consultant for Bromfield Associates.

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# News from Abroad

## German Plastics Progress

The plastics industry in Germany made further advances during 1957. Total output of plastic materials in 1957 came to 589,288 tons, as compared with 521,363 tons the year before. The following table compares production of the principal types of plastics in the two years:

| | 1957 | 1956 |
|---|---|---|
| Cellulose derivatives and Celluloid | 78,858 | 64,436 |
| Condensation products | 233,279 | 195,734 |
| Polymerization products | 277,151 | 261,193 |
| Total | 589,288 | 521,363 |

Manufacturers of plastic goods reported sales with a total value of 1.6-billion DM in 1957, as compared with 1.2-billion DM the previous year, representing an increase of about 34%.

Exports of manufacturers of plastics rose by 32% from 178,000,000 DM in 1956 to 236,000,000 DM in 1957. Preliminary figures indicate that production of plastic film accounted for 15% of total output of plastic products, and electrical parts for 12%. Production of packaging materials made considerable headway during 1957, so that this line represented 10% of total plastic manufactures. Output of pipe, tubing, and profiles doubled in 1957 over the preceding year, and foamed materials found many new outlets.

## Plastoglass

A new glass-reinforced vinyl material has been put on the market by the English firm, Storey's of Lancaster. Plastoglass, as it is called, is a composite material consisting of a fine, net-like web of glass fiber between two sheets of vinyl film. This material is said to have very high tensile strength, good dimensional stability and abrasion resistance, and resistance to ultra-violet light, weathering, mildew, rot, and chemicals. It is available in several grades including a relatively open-weave for general purposes, a grade for luggage, and a more compact and heavier material for heavy-duty and industrial purposes. It can be heat-welded to produce sturdy inflatable articles, and lends itself to decorative color printing. Applications suggested are for tents, waterproof covers for machines and the like, luggage, deck-chairs or other outdoor furniture, ducting, canoes, inflatable dinghies, etc.

## Plastics in South Africa

The plastics industry in South Africa continued to make progress in 1957, reports from various sources reveal. Sales increased markedly over those for 1956, and preliminary figures indicate a further increase in demand during the first quarter of 1958. At the same time, easier import regulations are disturbing local manufacturers who complain of competition from countries with low-wage scales.

Among new items made in South Africa are: plastic roller stamps, designed to be used without ink pads and claimed to give 1,000 impressions without need for fresh inking; illuminated plastic advertising displays; polyethylene doilies and shopping baskets; Perspex bowles; vinyl dolls; floor tiles; acoustic tiles; bricks of a foamed white plastic understood to have a polystyrene base; PVC industrial gloves in tubing; and cotton and duck fabrics coated with PVC paste for waterproof garments used in mining, fishing, canneries, and other industries where hard-wearing protective clothing is needed.

Unsupported plastic sheet and film in various thicknesses and colors for a wide range of applications are to be produced by African Explosives & Chemical Industries, Ltd., which reportedly has spent about $750,000 on new equipment for the purpose at their plant near Cape Town. These materials, for which there is a growing demand, hitherto had to be imported.

The increasing demand for Panelyte laminated plastic surfacing material by the local hardware and building trades led the firm that formerly imported it to begin manufacturing it in South Africa under license from the American company.

Under License also is being produced Metalloplastic liquid metallic zinc for cold galvanizing. This is a combination of powdered zinc, plastic compounds, and solvents, that is sprayed onto parts or objects already in position.

The Sagex group of Swiss industrialists has established a branch plant near Cape Town for the production of various plastic products. This plant began operating at the end of last year. Managers, technicians, foremen, and apparently even some of the workers were brought out from Switzerland, as was the up-to-date equipment. Among the items to be made are polystyrene-based insulations, PVC wall covering, and polyethylene hand rails.

## Polyethylene Pipe Prevents Freezing-up of Waterways

The well-known fact that the density of water is highest at 4° C. so that ice, which is formed at 0° C. and has a lower density, floats on a warmer layer of water, is the basis of a Swedish system which uses flexible polyethylene pipe to reduce to a minimum the freezing-up of harbors, lakes, canals, and other waterways.

The pipe is perforated at intervals of a few yards and is anchored under water at a sufficient height from the bottom to prevent contact with ooze and mud and, hence, clogging of the holes. Air blown into the pipe by a small compressor escapes through these perforations, setting up an eddy that constantly stirs the warmer water up from the lower depths to the surface, preventing the formation of ice.

The principle is not new, since earlier experiments with galvanized iron pipe had been carried out from time to time, but these were not successful because the pipe corroded and the perforations became clogged with rust and ooze. Moreover, the rigid iron pipe did not conform easily to the variable surfaces of water-beds. Large-scale application of the method, therefore, did not become practicable until the advent of the flexible polyethylene pipe.

This system also appears to have been used advantageously in tests in Canada, where it was applied to fish ponds.

## Plastics in Brazil

Domestic production of resins increased 22% in 1956, and imports decreased by 10%. Local production accounted for 79% of Brazil's needs that year, which amounted to 23,100 metric tons. New fields are opening up, and large sums are being invested in new installations. The majority of these are in the State of Sao Paolo, the center of the Brazilian plastics industry.

## Plastics in Cuba

Resins are not produced in Cuba, its plastics industry being restricted to nine injection molding firms, four compression molders, and four extruders (two of which are U. S. subsidiaries). Consumption seems to be increasing about 5% annually, and practically all of the materials used are imported from the United States. These amounted to approximately 4.5-million pounds in 1955.

The Cuban processing industry maintains a close relationship with U. S. industry through exclusive representatives in Cuba. There is no significant foreign investment, although several subsidiaries of American rubber-products are among the plastics-processing firms. Arrangements are made regularly with U. S. and Mexican manufacturers for the rental of molds.

# New Materials

*Write item numbers on Readers' Service Card to obtain more information.*

## High Density Polyethylene

A high density polyethylene, tradenamed Boltathene, has been placed on the market by General Tire & Rubber Co.'s Bolta Products division. The material is available in sheets up to 70 inches in width; thicknesses from six to 70 gage; and conforms to the following specifications:

| Property | | ASTM Test Method |
|---|---|---|
| Melt Index | 0.2-0.5 | D1238-52T |
| Density | 0.96 | |
| Izod Impact, ft.-lb./in. notch | 3-5 | D256-54T |
| Tensile strength, psi. | 3500-4500 | D412-51T Die C |
| Elongation, % | 40-200 | D412-51T Die C |
| Brittleness Temp. °F. | −106 to −180 | D746-55T |
| Flammability, in./min. | 0.8-1.1 | D635-44 |
| Hardness, Shore D | 60-70 | |
| Heat distortion temp., 264 psi. °F. | 120 | D648-45T |
| at 66 psi. °F. | 170 | |

*Readers' Service Item 1*

## Loadable Chemical Adsorbents

Many of the accelerators and catalysts used in curing plastics have been chosen not so much for being ideally suited for the reaction, but for their relatively low volatility, toxicity, and flammability. Although peroxides and ammonia have been used, their immediate incorporation gives a material with a poor pot life and practically no storageability. This necessitates the use of a two-component system.

Linde Co. has come up with a series of products which promise to allow commercial use of some of the more rapid, volatile and flammable accelerators and hardeners. Called Molecular Sieves, they are man-made crystalline alumino-silicates which act as adsorbents. Chemically similar to many natural clays and feldspars, they belong to the zeolite class of minerals which are characterized by their ability to undergo dehydration with little or no change in their crystal structure. Dehydrated, the crystals are interlaced with regularly-spaced channels or molecular pores which comprise almost 50% of their total volume.

Anhydrous molecular sieve crystals have a strong tendency to recapture water molecules or, if unavailable, polar molecules such as the very polar curing agents for resins and rubbers. Linde has loaded a large number of such compounds, including amines and peroxides, onto molecular sieves and evaluated them as latent curing aids. They are, in a sense, isolated from the rest of the formulation during storage and initial processing, and are released only by the application of heat or by displacement with a more strongly-adsorbable material.

At present, four of the five commercially-available sieves are rubber accelerators; however, CW-2015 is a ditertiary butyl peroxide used in curing rigid vinyl plastisols and epoxy resins. When used as a curing agent for epoxies, it gives increased storage stability and, in many cases, allows the use of a one-component system. This same feature is carried over into plastisol formulations plasticized with a monomeric material such as Union Carbide Chemical's Monomer MG-1. Here, the processor is effecting a diester polymerization through a peroxide catalyst. The end product is a plastisol of unusual hardness, dryness, and strength. Here again, pot life and storageability would be negligible were it not for the "tying-in" of the highly volatile peroxide.

Addition of benzoyl peroxide to Monomer MG-1 will cause gelling in less than five days at 122° F.; less than 20 minutes at 210° F. When CW-2015 is used as the catalyst, however, there is little change after 15 days at 122° F.; or after eight hours at 210° F. Implications are obvious when one considers that a hard resin is formed with either catalyst after five minutes at 350° F. Harwick Standard will be the exclusive distributor for the molecular sieves, which have adsorptive capacities up to 20-30 weight percent.

*Readers' Service Item 2*

## Glass-Epoxy Laminate

Rolled copper foil is being applied to a recently-developed glass-epoxy laminate, to form an improved version of Taylor Fibre Co.'s copper clad laminates for printed circuits. Designated GEC-500, the material is furnished plain or with copper cladding on one or both sides. The laminate exhibits low moisture absorption, excellent chemical resistance and insulation properties, low dielectric loss, and high mechanical strength.

The foil is bonded to the base laminate with an applied adhesive, or by making use of the natural adhesive properties of the epoxy resin. The latter grade is particularly useful where prolonged exposure to corrosive electrolytes is necessary. Hot solder tests on both types show that no blistering occurs when GEC-500 grades floated for more than 20 seconds, copper side down, in solder at 500° F. Oven tests revealed no blistering after a 30-minute exposure at 252° F.

The base laminate meets the requirements of MIL-P-18177A, and withstands discoloration when placed in various plating and etching baths. It is available in sheets measuring approximately 37 by 39 inches, with thicknesses ranging from 0.010-1½ inches; and rods in diameters from ⅛-1½ inches. Copper-clad grades measure 36 by 48 inches, and have thicknesses from 0.015-1 inch, inclusive.

*Readers' Service Item 3*

## Epoxide Casting Resin

A one-component, epoxide casting resin and impregnant, designated Stycast 2980, has been placed on the market by Emerson & Cuming, Inc. Used directly as supplied, the resin requires no additional curing agent, and can be used to impregnate and embed large metal objects such as transformers.


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Stycast 2980 is self-extinguishing after the application of flame. It withstands severe temperature cycling without cracking, and can be used in applications where temperatures may range from —70 to 400° F. A summary of its physical properties follows:

| | |
|---|---|
| Flexural strength, psi. | 15,000 |
| modulus, psi. | $4.3 \times 10^5$ |
| Water absorption (7 days), % | <0.1 |
| Dielectric constant, approx. | 3.4 |
| Dissipation factor | <0.015 |
| Volume resistivity (ohm-cm.), 70° F. | $2.3 \times 10^{16}$ |
| 300° F | $6 \times 10^{12}$ |
| Dielectric strength, volts/mil | 425 |

*Readers' Service Item 4*

## Epoxy Casting Materials

A series of epoxy casting, encapsulating, and embedding compounds, developed by Minneapolis-Honeywell Regulator Co.'s plastics products department and formerly used only in the manufacture of that company's control devices, has been made available recently to industry. The several types currently on the market are sold under the tradenames Sealcast and Sealfoam.

Sealcast 501 is a general purpose grade having room temperature handling and curing characteristics. It incorporates an inert filler which imparts a low shrinkage and thermal expansion coefficient, and is suitable for use in ambient temperatures up to 200° F. It cures to form a hard solid with a volume resistivity of $7 \times 10^{14}$ ohm-cm.

Sealcast 502, a high-temperature-resistant potting compound, cures at 150-200° F., and is designed for the embedment and encapsulation of electronic components. Characterized by a volume resistivity of $16 \times 10^{14}$ ohm-cm., this material may be used in temperatures ranging from —100° to 350° F.

A hermetic sealing material, designed for use around terminal wires and connector contacts, Sealcast 503 exhibits excellent resistance to thermal shock at temperatures below 250° F. It adheres well to most metals and to many other plastics, and has a volume resistivity of $14 \times 10^{14}$ ohm-cm.

Sealcast 504 is compounded for use in high temperature applications and where machining operations on the finished part are necessary. Temperature range is up to 350° F., and volume resistivity is $12 \times 10^{14}$ ohm-cm.

An unfilled resin curing at room temperature, Sealcast 505 can be used where a fairly high thermal expansion can be tolerated. It can be used to make fiber glass parts by hand lay-up methods, and will serve as an adhesive for metal, glass, and thermosetting plastics. With an operating temperature range up 200° F., grade 505's volume resistivity is greater than $2 \times 10^{14}$ ohm-cm.

Sealfoam 601 is a two-component casting resin curing at about 225° F. A shockproofing and thermal insulation material, its use is restricted to small components because of the fairly high exotherm produced during foaming. This material softens at 291° F., and has an insulation resistance greater than $10^{12}$ ohms.

A single-component, ready-to-use foaming resin, supplied as a free flowing powder, Sealfoam 603 is activated at 175-225° F. It first melts, then foams, and finally cures. In addition to encapsulation applications, this material can be used in the fabrication of thermal and acoustic insulation materials; and in the foaming of both reinforced and non-reinforced structural members including wall panel, doors, and similar components. Softening temperature is 226° F., and insulation resistance at 73° F. is greater than $10^{12}$ ohms.

Post-curing is not essential for the casting resins, although it is recommended where optimum properties are required. All of the compounds have a shelf-life of one to two years under normal storage conditions.

*Readers' Service Item 5*

## Two PVC Plasticizers

Primary and secondary PVC plasticizers, known respectively as Abcoflex A and Abcoflex B, have been placed on the market by Abco Chemical Co. The plasticizers are clear, viscous resins, suitable for use as stabilizers in vinyl foams to whch they impart good tensile strength and elongation properties.

The secondary plasticizer, Abcoflex B, may be used in conjunction with the company's "A" compound, or with any other primary plasticizer. Both types are resistant to ultra-violet light degradation and soapy water; and exhibit low migration and volatility properties. A summary of their physical characteristics follows:

| | Abcoflex A | Abcoflex B |
|---|---|---|
| Acid value, approx. | 1 | 1 |
| Specific gravity, 25° C. | 1.03 | 1.17 |
| Weight, lbs./gal. | 8.3 | 9.8 |
| Refractive index, 25° C. | 1.4859 | 1.4948 |
| Freezing pt. °F. | <—14 | <—14 |
| Viscosity, cps. | 63,000 | 590,000 |

*Readers' Service Item 6*

## Primary Vinyl Plasticizer

A fast-fusing primary plasticizer for PVC which is said to impart good general purpose properties to floor tile, plastisols, film, sheeting, and extrusions has been introduced by Monsanto Chemical Co.'s organic chemicals division. Trademarked Sanitizer 165, the material is a mixed alcohol phthalate offering heat and light stability and low-temperature flexibility equal to that of dioctyl phthalate. Volatility is slightly higher, but considerably lower than butyl octyl phthalate.

Shown below is a comparison of Sanitizer 165 to DOP and butyl octyl phthalate at a 67 PHR plasticizer level:

| | Santicizer 165 | DOP | Butyl octyl phthalate |
|---|---|---|---|
| Low temperature flex. Tf°C | —40 | —39 | —39 |
| Volatility % loss | 10.6 | 4.8 | 16 |
| Hardness, Shore A | 75 | 73 | 75 |
| After aging | 75 | 73 | 83 |
| Water extraction, % absorbed | 0.52 | 0.4 | 0.55 |
| % solubles extracted | 0.02 | 0.02 | 0.06 |
| Kerosene extraction, % loss | 23 | 35 | 20 |

Tentative specifications are listed for Saniticizer 165 as follows:

| | |
|---|---|
| Acidity, meq/100 grams | 0.12 |
| Color, APHA | 30 |
| Moisture content, % max. | 0.12 |
| Refractive index | 1.484-1.487 |
| Specific gravity | 0.989-0.994 |

*Readers' Service Item 7*

## Epoxy Flexibilizer-Hardener

A catalyst for the following liquid epoxy resins: Ciba's Araldite 6010, Bakelite's ERL 2774, Jones-Babney's Epi-Rez 510, or Shell's Epon 828, has been developed by Lancaster Chemical Corp. Designated Lancast-A, the material is recommended for use in the ratio of 67 parts to 100 parts resin. This proportion can be lowered to 50 parts or raised to 100 parts as the desired end properties warrant.

In appearance, Lancast-A is a clear liquid, and has the lowest viscosity of the flexibilizer-hardeners—six poises at 80° F. It reportedly has a very low toxicity. Specific gravity is 0.95, and the material weighs approximately 7.9 pounds per gallon.

*Readers' Service Item 8*

## Nylon Extrusion Compound

A high-melt-viscosity nylon compound, developed for the extrusion of large shapes, has been placed on the market by plastic and coal chemicals division, Allied Chemical Corp. A Plaskon product, designated 8205, the nylon can be extruded at stock temperatures ranging from 450-550° F.

Supplied in the form of cylindrical granules measuring 0.1 by 0.1 inch, the material lends itself to even stock temperature control, and produces a homogeneous melt facilitating the production of end products with close dimensional tolerances.

Its high-melt viscosity is retained through successive regrinds and, with proper handling, it can be re-extruded several times.

The compound is expected to find application in the extrusion of structural forms where light weight and moderate strength are required; air and exhaust ducts used in the handling of corrosive, poisonous, or solvent fumes; and in pipes, tubing, tapes, and other engineering components. Packaged under inert gas in 25-pound, air-tight, containers, Plaskon Nylon 8205 conforms to the following physical specifications.

Tests conducted after conditioning for 48 hrs., at 73° F., and 50% R.H.:

| | |
|---|---|
| Tensile strength: | |
| Yield point, psi. | 8,500 |
| Ultimate, psi. | 12,000 |
| Elongation, % | 200 |
| Flexural strength, psi. | 14,000 |
| Modulus, psi. | 330,000 |
| Specific gravity | 1.13 |
| Shear strength | 8,200 |

Tests conducted after conditioning for 96 hrs., at 73° F., and 50% R.H.:

| | |
|---|---|
| Izod impact, ft.-lb./in. notch | 1.2 |
| Heat distortion temp., 264 psi., °F. | 149 |
| Hardness, Rockwell R. | 118 |

Tests conducted after conditioning for 16 hrs., at 122° F.:

| | |
|---|---|
| Deformation under load, %: | |
| 122° F., 2,000 psi. | 1.2 |

*Readers' Service Item 9*

## Low Temperature Adhesive

A two-component, internal-setting adhesive for bonding rigid insulations such as expanded polystyrene, cork, and rock cork, has been introduced under the tradename Insulgrip, by Borden Chemical Co.'s coatings and adhesives department. Component ingredients include an asphalt fluxing oil and a powdered aggregate; the two being blended just prior to application.

Black, mild-odored, and non-toxic, Insulgrip is applied with a trowel and dries in ½ to three or four days to form a strong, waterproof bond. It may be stored indefinitely in an unopened package, but after blending must be used within 15-30 minutes. Since lower temperatures delay the set of the material and permit longer working time, application is best achieved near 50° F.

The adhesive is supplied in unit form consisting of a five gallon pail (40 pounds) of thermoplastic flux, and one 60-pound bag containing a dry blend of resins and mineral fibers. One pound of the material will give a ⅛-inch coating over a one square foot area.

*Readers' Service Item 10*

## Reinforced Plastics Lacquer

A transparent lacquer for coating either corrugated or flat panels of glass-reinforced polyesters has been introduced by the Durez Plastics division of Hooker Chemical Corp. Called Hetrolac 105, the material has been subjected to severe and lengthy exposure tests and was shown to inhibit discoloration and other degradation.

Clear, non-pigmented panels were coated with 0.2-mil thicknesses of Hetrolac 105, and exposed at a 45° angle facing south in Miami, Fla. After 1½ years, the panels showed no effects of the weathering. White pigmented panels, tested under the same conditions, also showed no adverse effects. They passed repeated 180° angle flexing tests at room temperature, at —13° F., and at +176° F., with no signs of coating failure.

Hetrolac 105 can be brushed or sprayed, will dry tack-free in 5-10 minutes, and can be stored indefinitely in closed containers. It can be used over old panels to seal-in exposed glass fibers and retard further deterioration. The lacquer should be used as supplied, and the panel surfaces should be clean and dry.

*Readers' Service Item 11*

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# New Equipment

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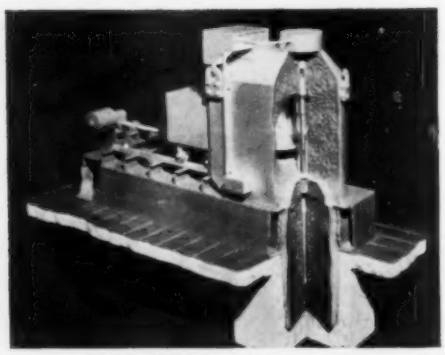

Nuclear Systems' Model A Hotrodder.

## Cobalt-60 Irradiator

A self-contained gamma radiation tool, utilizing up to 25,000 curies of cobalt-60, has been developed by Budd Co.'s Nuclear Systems division. Called Model A Hotrodder, this unit can be installed with complete safety in any position where floor loading requirements can be met. No auxiliary radiation monitoring, extra shielding, or remote handling equipment are required.

The Hotrodder has an irradiation chamber sufficiently large to receive samples 10 inches in diameter by 10 inches in length. Outer construction is of stainless steel, and a filling of pure, void-free lead acts as a shield. The 25,000-curie radiation source is in the form of a rod measuring ⅝-inch in diameter by 17 inches in length. This shape is said to allow a greater versatility in flux configurations than does the conventional annular shaped source. For instance, if the sample is rotated on an axis parallel to that of the rod, the effect is the same as though it had been placed in an annular source whose radius is equal to the centerline separation between them.

Automatic features of the unit simplify operation. After the sample has been inserted in the irradiation chamber, the operator pushes a single button on the control console; the chamber door closes, and the radiation source moves into position. The amount of exposure is controlled by a timer which can be preset to various intervals ranging from less than one minute to 120 hours. Both the chamber door, and the source mechanism are provided with electrical and mechanical interlocks which prevent the source being moved into the exposed position while the sample door is open.

Model A is designed to stand approximately five feet above, and 2½ feet below the floor level; occupies an area of 2½ by 7½ feet; and weighs about seven tons. Although units may be wired for any available power source, the standard models call 110 volt, 220 cycle, a.c. Tubular access parts permit the sample to be connected with outside water, gas, or electrical lines during irradiation.

*Readers' Service Item 20*

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## Urethane Foam Mixer

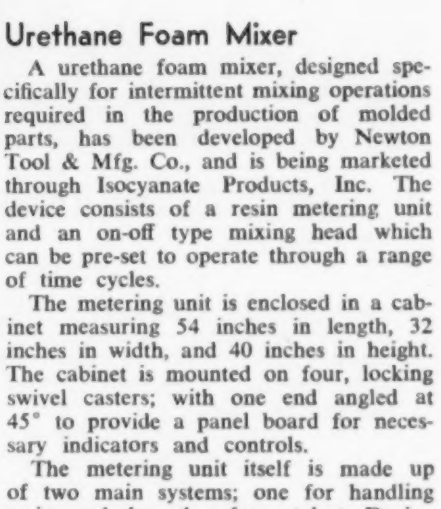
A urethane foam mixer, designed specifically for intermittent mixing operations required in the production of molded parts, has been developed by Newton Tool & Mfg. Co., and is being marketed through Isocyanate Products, Inc. The device consists of a resin metering unit and an on-off type mixing head which can be pre-set to operate through a range of time cycles.

The metering unit is enclosed in a cabinet measuring 54 inches in length, 32 inches in width, and 40 inches in height. The cabinet is mounted on four, locking swivel casters; with one end angled at 45° to provide a panel board for necessary indicators and controls.

The metering unit itself is made up of two main systems; one for handling resin, and the other for catalyst. During operation, a 10-gallon storage tank and a two-gallon stainless steel reservoir gravity-fed resin and catalyst, respectively, to two separate positive-displacement pumps. Moving at rates ranging from ½-10 pounds per minute, the resin travels through a heat exchanger, and finally through a three-way Teflon plug valve with which it may be recycled to the resin pot or diverted to the mixing head. Upon discharge from its pump, the catalyst is metered through a flow-rater before being combined with the resin.

The mixing head is the focal point of the two material paths, and is adapted to receive several variable speed drive systems. Resin and catalyst are drawn into the mixing chamber by a triple-sectioned blade which serves to blend the materials and expel them.

*Readers' Service Item 21*



Newton Tool & Mfg. foam mixer.

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Nemco plastics weighfeeder

## Plug-In Plastics Weighfeeder

A new weighfeeder which is adjustable to all makes of plastic injection molding machines is available from Rainville Co., Inc. Designed and built by New England Engineering & Mfg. Co., the unit requires no air piping and needs only to be plugged-into any convenient socket.

The weighing scale has two sets of clear graduations and two balancing weights for regular amd micro settings, with a guaranteed accuracy of +1 gram. A patented electrical compensator monitors every shot. Lower mold-locking pressure can be used, and 100% increases in projected molding area are reported.

*Readers' Service Item 22*

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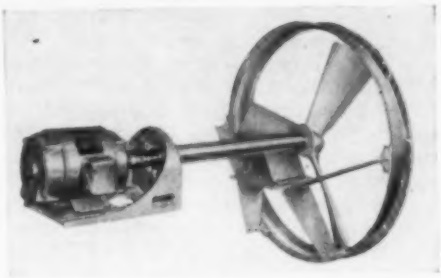
## Extension Shaft Fans

A line of axial flow, extension shaft fans for exhausting contaminated fumes



The Propellair Type CE industrial fan.

from installations requiring isolation of the fan motor and the air stream have been placed on the market by Propellair Div., Robbins & Myers, Inc. Designated Type CE, the fans are non-overloading and suitable for use over a wide range of operating conditions.

Propellers are available in various multi-blade, air-foil designs. They are made of cast aluminum-magnesium alloy, fitted with heavy-duty flexible couplings and oversized drive shafts and bearing assemblies. Bearings are sealed and prelubricated with silicone grease for service up to 200° F. For higher temperatures, shaft cooling and lubricable bearings are recommended.

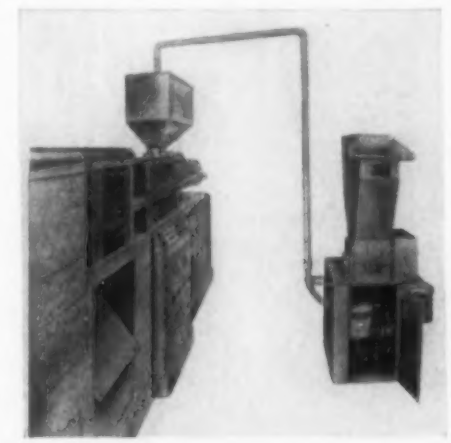
Drive motors are available in a variety of types for a.c. or d.c. power sources; and in explosion-proof, totally enclosed, and glass insulated constructions. Over the standard size range (12-60 inches in diameter), the fans deliver free-air quantities beginning at a maximum 1,600 cfm. for the smallest model, and reaching 79,000 cfm. for the largest. Extension shafts can be supplied in lengths from 16-66 inches.

*Readers' Service Item 23*

## Pneumatic Feed Attachment

A pneumatically operated device for returning granulated materials from a beside-the-press granulator directly to the hopper of an injection molding or extrusion machine is available from Ball & Jewell, for use with their Marvel series granulators. Called Loadamatic, the accessory eliminates manual transfer of materials through the introduction of a low pressure pneumatic system which removes the material as it is ground and forces it through a pipe to the machine-hopper.

Operating capacity of the Loadamatic depends on that of the granulator which, in turn, is available with production rates of 75-, 200-, 300-, and 400-pounds per hour. Components of the device are self-contained within the bin compartment of the granulator and add approximately 15-25 pounds to its weight, depending on the size of the machine. There is no change in the basic floor dimensions required.



Opened, the bin compartment reveals an air evacuator used to actuate the Loadamatic. Piping is shown, leading to the machine hopper.

*Readers' Service Item 24*

## Bench Injection Machine

A hand-operated, bench type, injection molding machine, designed for production runs at speeds up to 400 shots per hour,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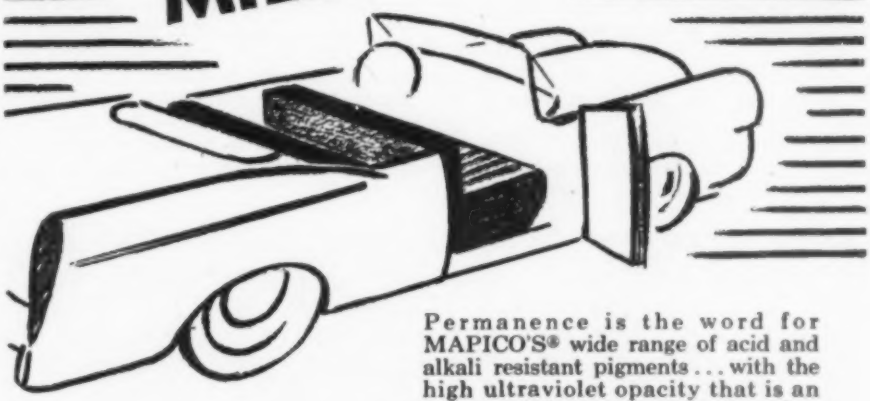

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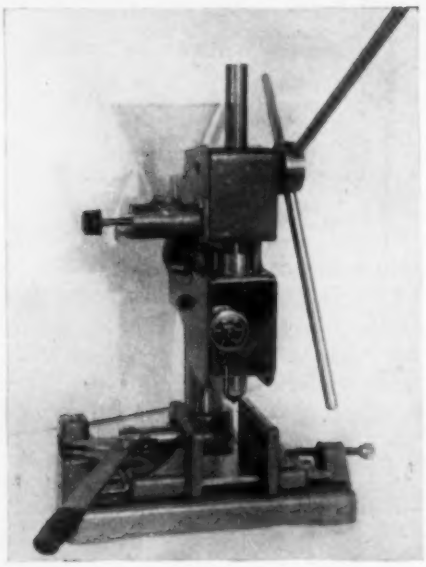

S. R. Seymour's bench model injection molding machine.

has been placed on the market by the British firm, S. R. Seymour & Co., Ltd. The unit incorporates a semi-automatic hopper feed, and a lever-operated vice-ejector which opens the mold and ejects the finished part in one operation.

Provision is made for both horizontal and vertical adjustments so that a variety of mold sizes can be accommodated. A thermostatically-controlled heating unit draws 250 watts, and requires a 220/240 volt a.c. power source. Operating temperatures range from 0-300° C., and the system is provided with a neon warning light and thermometer.

The machine is provided with a sturdy cast base and head; nickel-chrome steel cylinder and ram; and is finished in antique bronze. Other specifications include:

| | |
|---|---|
| Ram, dia., in | 0.807 |
| Length, in | 2.812 |
| Platen area, in | 5 x 2.5 |
| Daylight opening, max., in | 5 |
| Min., in | 3.125 |
| Cylinder cap., gms | 21 |
| Recommended shot, max., gms | 15 |

*Readers' Service Item 25*

## Induction Heated Extruder

A series of induction heated extruders capable of producing higher quality, closer tolerance extrusions through finer temperature control have been developed by National Rubber Machinery Co. Similar in basic design to the company's standard machines, the redesigned series differs primarily in the incorporation of induction heaters which cause heat to originate within the walls of the cylinder rather than at an outside source.

Induction heaters make use of the expanding and collapsing magnetic fields generated about a conductor carrying an alternating current. When the field penetrates a magnetic material, such as the steel cylinder walls, hysteresis losses, brought about by molecular friction, reappear as heat energy in an amount that is directly proportional to the frequency of vibration and the field strength.

The main advantage of this application derives from the fact that heat is generated evenly throughout the heating zone. This reduces the high temperature gradient normal to externally heated cylinders, and eliminates the danger of overheating since no part of the system is at a dangerous temperature level. Control response is rapid within the operating temperature range of 0-650° F.

In the 2½-inch extruder, which is currently available, the induction coils are designed for operation with 208- or 230-volt, 3-phase, 60-cycle current. The coils are slipped over the cylinder and are positioned at each of the four heating zones. An air space between the coil and the cylinder wall permits the passage of cooling air that is supplied by a blower. Each heating zone is monitored by a single position pyrometer, and a safety-type thermostat to prevent excessive overheating of the induction coils in case of a work slow-down or stoppage. While the heating system currently is confined to the one size extruder, the company expects to have 3½- and 4½-inch models available in the near future.

*Readers' Service Item 26*


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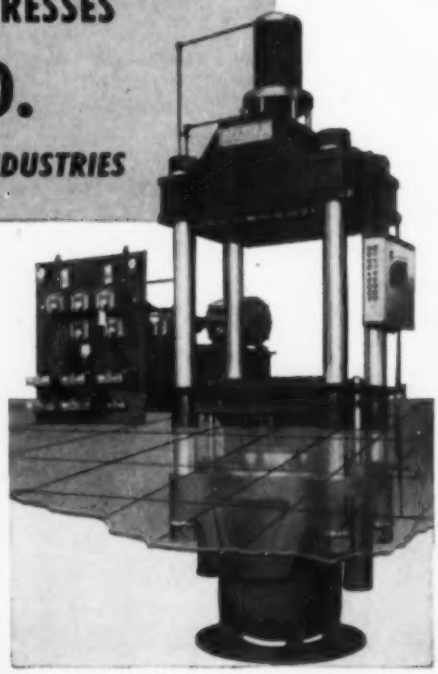

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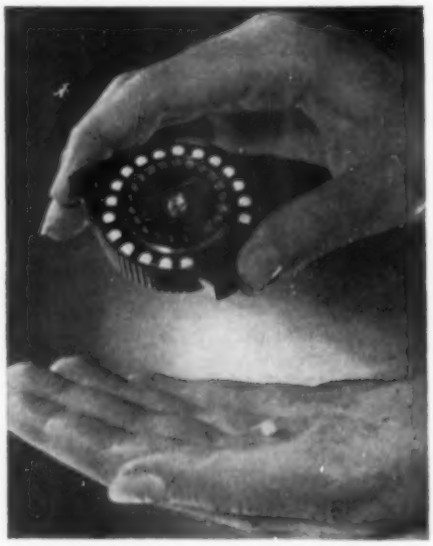
# *Plastics Applications*

*Write item numbers on Readers' Service Card to obtain more information.*



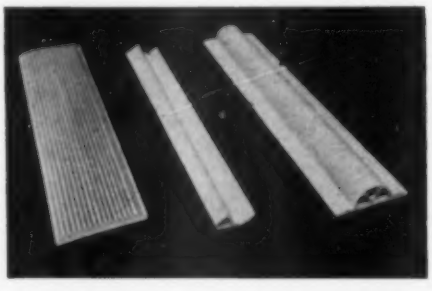
Butyrate tablet dispenser-counter.

## Butyrate Counter-Dispenser

A plastic dispenser for narcotic tablets and the like which require positive control is available from Cole-Sewell Engineering Co., as part of its hospital narcotic-control cabinet. All parts are molded from Eastman's Tenite butyrate by Rainbow Plastic Products, Inc., and include: a red, easily-gripped case, a red, rotating disc which holds the tablets; a clear dispensing plunger; and a transparent face for taking immediate inventory.

The dispenser holds 20 tablets, which are released one at a time by pressing the plunger. For refilling, the manufacturer provides a small plastic tool for removing the face. Easy to read raised numbers are coated in white.

*Readers' Service Item 30*



Vinyl bumpers for small boats and docks.

## Vinyl Boat and Dock Bumpers

Extruded vinyl bumpers for small boats and docks are being marketed by Columbian Rope Co. White in color, the welting is available in two widths: 1½ inches and 2⅛ inches. The narrower bumper can be purchased in 50-, 100-, and 250-foot lengths; the wider in 100-foot lengths.

A second-grade bumper, black in color, will be available in 100-foot lengths. This welting is intended for large Marinas where color and finish is secondary to price in importance. Tough, resilient, and weather-proof, the bumpers will not mark boat finishes.

*Readers' Service Item 31*

## Nylon Street-Sweeping Broom

Considerable economies in the cleaning of highways and city streets may be realized in the very near future thanks to a new Du Pont development, Tynex nylon monofilament. Recently tested in mechanical sweeper brooms in several cities, Tynex was shown to outlast standard vegetable fibers many times over. Average service life of the standard broom was shown to be 150-200 sweeping miles, as opposed to 4,000 miles for the Tynex brooms.

City of Philadelphia reported very favorable results using this street cleaning broom of Tynex nylon monofilaments.

Sweeping performance of the nylon monofilament brooms was reportedly as outstanding as their abrasion resistance. In Philadelphia, operators stated that the new brooms picked up all types of litter from fine silt to whole bricks. They were used also for snow removal.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In cable-wrap constructions, 26-inch cuts of 75-mill Tynex yielded brooms with 12-inch trim and a useful length of seven inches. Average wear rate was about an inch for every 600 miles. Strip brush constructions required 24-inch cuts of the 75-mil material. One strip brush wore but 0.81 inch for 632 sweeping miles.

Though initial cost is higher, the resultant savings are obvious. By reducing the rebristling rate and lowering general maintenance costs, it is estimated that the nylon-bristled sweepers will reduce a large city's street cleaning costs by 90%. Approximately 5.5 pounds of Tynex are required for every two inches of broom core.

*Readers' Service Item 32*

Samples of wrapping paper and shelf liner are shown packaged in Trycite, Dow's oriented polystyrene film.

## Polystyrene Film

A recently-developed fabricating technique has enabled Dow Chemical Co., to market an oriented polystyrene packaging film in one to two mil thicknesses at prices competitive with other transparent materials used in these applications. Tradenamed Trycite, the new product will be made in Cleveland, O., where production facilities are scheduled to go on stream in January 1959.

Possessing all of the physical and chemical properties inherent in polystyrene, this material will compete with cellophane and acetate films which are clear and relatively stiff. It exhibits excellent dimensional stability, and maintains its smoothness and lustre for the entire shelf-life of the packaged product.

A breathing film that does not absorb moisture, nor distort and become brittle with age, Trycite finds its primary market as a foodstuff and soft-goods wrapper. Other possibilities include: see-through windows for envelopes, cartons, and boxes; and in the packaging of confectioneries, dairy products, groceries, and pharmaceutical supplies.

Certain coatings have been developed to make the material readily heat-sealable and more functional for standard equipment. Trycite currently is available in one, 1¼, 1½, and two mil thicknesses, and in widths from one to 54 inches.

*Readers' Service Item 33*

## Corrosion-Resistant Faucet

A corrosion-resistant faucet for dispensing flammable and corrosive fluids is available from the Eco Engineering division of Economy Faucet Co. Constructed of 303 stainless steel with Teflon O-ring seals, the faucet thus provides fluid- and vapor-tight seals over a wide temperature range. An internal pressure system eliminates seizure problems prevalent with mechanically preloaded dispensing equipment.

In recenty-conducted tests, it was shown that the anti-flash screen prevented any flames from entering storage drums through the spout. The faucet is self-closing when not held open manually, and a guard keeps the unit from being jammed in the open position. The faucet actually consists of two sections: a shank, which remains a permanent installation in the drum; and the dispensing end, which may be removed for chemical or steam sterilization. A stainless steel screw cap with Teflon seal is available as optional equipment to seal the shank. Shanks can be supplied in diameters of ⅜-, ¾- and ½-inch with tapered threads. All three are interchangeable.

*Readers' Service Item 34*

## High-Strength Phenolic Tubing

A line of small-diameter, paper-based phenolic tubing for use in mechanical and electrical assemblies is available from National Vulcanized Fibre Co. Designated Phenolite Grade XX-3113, the rolled tubing's high internal burst strength suggests its use where metal tubes or studs are to be inserted into tubular plastic insulators. Brush-holder assemblies, insulated bushings, and the like all call for press-fitted assembly.

The tubing is available in inside diameter sizes ranging from 0.093-0.379 inch; in wall thicknesses from 0.01-5/64 inch, depending upon piping size; and in lengths to 25 inches. The tubing has a natural color, and shows the following typical radiation-compression value: 179 pounds for 0.014-inch I.D. by 0.164-inch O.D. tubing. It has an axial compression strength of 17,100 psi., a density of 1.2-1.25 grams per cubic centimeter, and a water-absorption gain of 5.1-5.65%. This grade meets NEMA specifications for Grade XX rolled tubing.

*Readers' Service Item 35*

East Coast's polyethylene aqua fins.

## Polyethylene Swim Assist-Ski

A newly-designed plastic fin which can be used as a swimming assist or water ski has been placed on the market by East Coast Plastic Products. Called the Swept-Wing Aqua Fin, it is molded by Reliance Plastics from Koppers Co.'s Dylan polyethylene.

The new fins actually have "wings" which fold on the forward stroke and open on the push stroke. Their large overall area (260 square inches) gives twice the forward propulsion of many other swim devices. Lighter than their rubber counterparts by about ⅓, the aqua fins are less tiring—and they float! Their construction affords ease in walking around the beach or pool.

Easily operable by either beginners or experts, the Swept-Wing Aqua Fin can be used in any swimming position. Three sizes are available: small, medium, and large; and three colors; ivory, coral, and green. Salt water and chlorine do not affect them.

*Realers' Service Item 36*

## Plastic Scintillators

Featuring optical clarity, a line of plastic scintillators for detecting nuclear radiation are available from the Dajac Laboratories of Borden Co.'s chemical division. Improved manufacturing methods permit their production in a variety of shapes, forms, and sizes. In addition to standard compositions, they can be supplied with special primary and secondary solutes.

The Dajac scintillators are suitable for alpha, beta, and gamma counting. They have high pulse rates relative to anthracene, short decay periods, and are suitable for anti-coincidence experiments, cosmic ray applications, and geophysical instruments. In the medical field, they can detect $I^{131}$ gamma rays in thyroid uptake measurements. By using a Dajac scintillator capable of holding a 60-80 ml. sample, the sensitivity in counting Cobalt-60 is 20 times that of a standard sodium iodide well.

*Readers' Service Item 37*

## All-Nylon Cable Clamps

Du Pont's Zytel 101 nylon is finding new use in the line of cable clamps produced by Richco Plastic Co. Strong, resilient, and flexible, the clamps are installed quicker than metal clamps and will not cause cutting or short-out. The line comprises 13 sizes from ⅛-inch I.D. to one inch. Clamps are ⅜-inch wide in sizes up to ½-inch, 9/16-inch wide thereafter. Approved under military specification P20693, they are recommended for service temperatures ranging from —60 to plus 300° F.

Richco all-nylon cable clamps.

*Readers' Service Item 38*

## Throw-Away Polystyrene Cups

Throw-away plastic cups, competitive in price with paper cups, have been introduced by Federal Tool Corp. Made from a heat-resistant styrene, the cup holds a full seven ounces of coffee, soup, or medicament. A major feature is the folding handle which locks in slip-proof grooves. Heat is not transmitted to the handle or beveled lip. The cups are ivory in color, and are packed 15 to the carton.

Disposable polystryene cups.

*Readers' Service Item 39*


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# New Literature

*Write item numbers on Readers' Service card to obtain copies.*

**"New Air-Loc Wedgmount."** Clark-Cutler-McDermott Co. 4 pages. Actually a screw-operated level for machines and other equipment, it operates on the double-wedge principle with 4:1 top wedge ratio. Patented Air-Loc pads, top and bottom, cut noise and vibration. Made from cork and fiber impregnated with vinyl, they are very resistant to oils and other chemicals.

*Readers' Service Item 40*

**"Poly-Eth 2477."** Spencer Chemical Co. 1 page. Average property values are reported along with the test method used.

*Readers' Service Item 41*

**"Poly-Eth 2476."** Spencer Chemical Co. 1 page. Average property values and test methods are reported for this blown-film extrusion grade of polyethylene.

*Readers' Service Item 42*

**"GP Information Bulletin. General Plastics Corp.** 4 pages. Teflon, Kel-F, Gencote, and Genton coatings are described along with Armalon woven glass fabric. Other specialties of the company are described briefly.

*Readers' Service Item 43*

**"Plastics Catalog and Price List."** Cadillac Plastic & Chemical Co. 64 pages. Listed herein are sizes, weights, color ranges, textures, specifications, grades, and prices for the firm's line of sheets, rods, tubes, films, lay-flat tubing, cements, pigments, and other materials. A two-page comparison table of chemical, electrical, and mechanical properties is included.

*Readers' Service Item 44*

**"Naxol."** Technical Bulletin I-20. National Aniline division, Allied Chemical Corp. 32 pages. Properties and reactions of this cyclohexanol are listed in this bulletin. An unusual chemical intermediate, Naxol has application in paint, varnishes, lacquers, plasticizers, petroleum processing, dyes, and a host of other chemical uses.

*Readers' Service Item 45*

**"Trinseel Sub-Miniature Teflon Terminals."** Trinseel, Inc., division of Tri-Point Plastics, Inc. 8 pages. This catalog lists dimensions and performance data for over 200 types of sub-miniature Teflon terminals. These include stand-offs, feed-thrus, plugs, jacks, and specialty terminals.

*Readers' Service Item 46*

**"H-VW-M Plastic Buffing Compounds."** Bulletin PBC-100. Hanson-Van Winkle-Munning Co. 2 pages. Three, static-free buffing compounds for plastic materials are described in this bulletin. Data is given also for six plastic bobbing materials.

*Readers' Service Item 47*

**"Southwestern Kralastic-PVC-Butyrate Plastic Pipe."** Southwestern Plastic Pipe Co. 4 pages. Features and applications for the above mentioned items are described, as is the firm's line of flexible polyethylene piping.

*Readers' Service Item 48*

**"Epoxweld 100."** Technical Bulletin 114. Duramic Products, Inc. 2 pages. This single-component epoxy preform is described along with data on its cure, time cycle, sizes, and available shapes.

*Readers' Service Item 49*

**"Transparent Plastics."** Homalite Corp. 6 pages. Physical and chemical properties for six clear plastics and a coating material for emergency repairs are given in this bulletin. Advantages offered by the former include corrosion resistance, abrasion resistance, crazing resistance, machinability, and temperature resistance.

*Readers' Service Item 50*

**"Junior Chil-Er Recirculating Units."** Mayer Refrigerating Engineers, Inc. 4 pages. These units can be used with injection molding machines for dip-bath cooling of molded plastics, thus eliminating distortion, warp, and sinks in parts with heavy cross sections.

*Readers' Service Item 51*

**"From Flying Machines to Flyrods, From Rockets to Radios."** Silicones division, Union Carbide Corp. 8 pages. The brochure describes how silane finishes A1100 and A172 are used with reinforced plastics to impart added heat and moisture resistance, added initial strength, and improved electrical properties.

*Readers' Service Item 52*

**"G-1057."** Logo, Inc. 2 pages. This bulletin describes techniques for filling recessed letters, symbols, and numerals with paint. Coatings and dry wipes are explained, along with machine applications and different types of masks which can be used.

*Readers' Service Item 53*

**"Production of Gamma Radiation with a Linear Electron Accelerator."** Report AM-100. Applied Radiation Corp. 14 pages. A unique report on the generation of gamma rays (Bremsstrahlung) for research and commercial processing. They are used for thick sections (over 6-8 inches), to penetrate high-pressure chemical processing systems, and to achieve low dose rates in some reactions. Linear electron accelerators are purported in this article to be the most convenient and economic source of radiation. All data is documented thoroughly.

*Readers' Service Item 54*

**"Indulin."** Polychemicals division, West Virginia Pulp & Paper Co. 20 pages. An extender for phenolic and furan resins, Indulin finds usage in paper sheet laminates, foundry cores, shell molds, plywood adhesives, and fibrous glass mats. It can be used to replace up to 50% or more of resin, depending upon the end usage.

*Readers' Service Item 55*

**"Laboratory Equipment and Machinery for Processing Plastics and Rubber."** Stewart Bolling & Co., Inc. Catalog No. 58-L. 26 pages. Illustrations and specifications are included for the firm's mills, refiners, calenders, presses, hydraulics units, mixers, and other production equipment.

*Readers' Service Item 56*

**"Plastics Tooling with Epocast."** Furane Plastics, Inc. 4 pages. The basic operations for preparing plastic tools are covered in this illustrated bulletin. Schematic drawings are included, and a number of the firm's epoxy materials are described in some detail.

*Readers' Service Item 57*

# Book Reviews

**"Molykote."** Alpha Molykote Corp. 24 pages. This manual describes the preparation of metal surfaces for the proper application of Molykote resin bonded lubricant coatings. Degreasing, phosphating, sandblasting, anodizing, bright-dip treatment, and phosphate fluoride processes are covered, as well as application of the lubricant coating and required baking times.

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**"The Branching Reaction in Polymerization of Styrene and Methyl Methacrylate."** M. Morton, I. Piirma, and J. A. Cala, University of Akron for Wright Air Development Center. Order PB 131094 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 62 pages. Price, $1.75.

Certain sulfur, oxygen, and carbon-headed free radicals were investigated to determine their relative activities in abstracting hydrogen from a given compound. Chain transfer activity of the following compounds in the polymerization of styrene was measured: 2-methyl-2-propanethiol, 2-methylpropionitrile, 2-propanol, and 2-methyl-2-propanol. The transfer constants of polystyrene and poly(methyl methacrylate) in the homopolymerization and graft copolymerization of styrene and methyl methacrylate also were established.

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**"Van Nostrand's Scientific Encyclopedia."** Third edition. D. Van Nostrand Co., Inc. Princeton, N. J. Cloth, 8½ by 11 inches. 1,839 pages. Price, $30.00.

A basic reference work on science and engineering, this one-volume encyclopedia places at the reader's disposal a vast supply of information on specialties other than his own. Contained between its covers are more than 100,000 definitions which were compiled by a 36-man editorial board to bridge the gap between the several fields of scientific and technological inquiry.

The book deals with 25 main subject areas including: chemistry, chemical engineering, nuclear science and engineering, physics, electrical and mechanical engineering, medicine, mineralogy, mathematics, and statistics. Topics are arranged alphabetically; are explained as simply as possible in the first paragraph; and then expanded to include more detailed and advanced information.

A unique cross-referencing system uses bold-face type to indicate basic terms whose definition may be necessary to understand a given article. Words and phrases thus indicated may be found in their proper alphabetical sequence.

Within a given definition, parts or types of the entity under consideration are grouped under the parent heading so that all information can be found in one place. Under "Plastics" for instance, a topic to which nearly five pages are devoted, the discussion begins with a generalized definition of the term including an explanation of the roles played by binders, fillers, solvents, plasticizers, lubricants, accelerators, dyes, and hardeners.

The behavior of thermoplastic and thermosetting resins is outlined and the principle groups of each type are listed. Among the thermoplastics, vinyl polymers have been given special consideration. Incorporated in the text are two flow diagrams; one for the manufacturer of products from vinyl chloride-vinyl acetate copolymer, and the other for the manufacture of polyvinyl-butyral, -acetal, and -formal resins. Ethylene polymers, polystyrene, coumarone-indene, and acrylics also are described. Thermosets are represented with discussions of phenol- and urea formaldehydes, melamine, alkyds, epoxies, and unsaturated polyesters. Polyurethanes and isocyanates, which may be either thermoplastic or thermosetting, are treated briefly as are the silicones and natural resins. The article closes with a short description of three molding methods, and a brief explanation of the reactions involved in forming thermosetting shapes.

A valuable addition to any technical library, Van Nostrand's Scientific Encyclopedia provides concise yet comprehensive explanations which can serve as a point of departure for further research where necessary. Chemical definitions are amply illustrated with structural formulas to show probable molecular configurations; and more than 1,400 pictures and diagrams are used to clarify other phases of the text.

---

**"L-O-C Fume Washer."** Lino-O-Coat Industrial Equipment. 4 pages. This leaflet describes the company's series of semi- or fully-automatic fume washers made from fiber glass. Dimensional specifications of the various models are tabulated, and a line drawing illustrates the arrangement of fittings and connections.

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**"The Oxidation Degradation of Large Molecules."** H. C. Beachell, University of Delaware for Wright Air Development Center. Order PB 131384 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 43 pages. Price $1.25.

Oxidation degradation studies revealed that high density polyethylene has a higher activation energy of deterioration than the common varieties. Rate data were interpretated by the Elovich equation for heterogenous reaction at a gas-solid interface.

Polystyrene and deuteropolystyrenes were studied by carbonyl development and oxygen adsorption. Results indicated a free radical mechanism via peroxide formation. Design and use of a cobalt-60 source for studies of radiation effects on high polymers is discusssed.


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# Abstracts of Important Articles

## Materials

**"New Flexible Epoxy Resins,"** John Delmonte, *Western Plastics*, 5, 3, 29 (March 1958).

A brief discussion of Epocast flexible epoxy resins, with special attention to their properties, viscosity and hardness characteristics, curing, and applications.

**"Mechanical Properties of Thin Polyethylene Film,"** A. A. Anderson and G. L. Morfitt, *Modern Plastics*, 35, 8, 139 (April 1958).

An apparatus is described for the determination of stress-strain characteristics of thin films at elongation rates of 0.03-6 inches per second and temperatures down to —70° C. The effects of these variables on the stress-strain properties are discussed, and it is shown that the ultimate strength and yield stress of the film and its seals increases with decreasing temperature.

**"Electrical Properties of Modified Epoxy Resins,"** John Delmonte, *Modern Plastics*, 35, 8, 152 (April 1958).

The addition of polyethylene glycols to dodecynyl succinic anhydride-epoxy systems is shown to increase the mol ratio of anhydride: epoxy needed for optimum properties.

**"Creep in Polyethylene at Elevated Temperatures,"** R. R. Dixon, *SPE J.*, 14, 4, 23 (April 1958).

Design limitations of polyethylene are discussed, and there is brief mention of the test method and results for creep at elevated temperatures. The need for a short-time test method is stressed

**"Polyesters of Dimer Acids as Intermediates for Urethane Foams,"** R. D. Aylesworth, R. H. Boehringer, D. T. Moore, and M. H. Smith, *Modern Plastics*, 35, 9, 145 (May 1958).

Methods of polyester and flexible foam preparation are given for a urethane system based on polyesters of dimer acids. Success of any one of the three competing systems for flexible foam is shown to depend largely on foam density, adaptability to commercial foaming, and ability to meet the requirements of specific applications.

**"'Delrin'—A New Thermoplastic,"** J. F. Cogdell and R. H. Hardesty, *SPE J.*, 14, 4, 25 (April 1958).

The new acetal resin, expected to be in commercial availability next year, is described. Chemistry, properties, end-use evaluation testing, processing, molds, and mold designs for the new resin are discussed.

**"Kaolinite Fractions, Their Effect on Physical Properties of Reinforced Plastics,"** G. P. Larson, *Modern Plastics*, 35, 9, 157 (May 1958).

A review of Kaolinite (china clay) and its uses as fillers in polyesters, diallyl phthalate, and phenolic resins.

**"Internal Stresses in PVC Insulations,"** F. O. Glander, *Kunststoffe*, 47, 12, 678 (Dec. 1957).

How the forming temperature of gelled, plasticized PVC compounds affects the mechanical properties of the end product is investigated, with regard to extruded sheathing on metal conductors. When processing takes place below optimum temperature, internal stresses increase and, as a result, tensile strength and elongation values fall off as temperature drops. This situation can be remedied to some extent by heat tempering. However, the PVC shrinks considerably, and cable sheathing cracks. The difficulties can be avoided in extruded insulations by suitable design of extrusion nozzle, or preheating the wire. (In German.)

**"The Kinetics of the Hardening of Epoxy Resins,"** G. Kannebley, *Kunststoffe*, 47, 12, 693 (Dec. 1957).

During the hardening of epoxy resins, several reactions that influence each other take place simultaneously. The different reaction stages can be studied separately with the aid of specimen substances. When acid anhydrides are used in hardening, the chemico-technological properties of the resulting resins can be explained satisfactorily by determining the rate constants and activation energies of the individual reaction stages. Amine hardening, however, is not such a step-wise reaction. The rate of reaction depends not only on the basicity of the amines, but also largely on the constitutions of the epoxide components. (In German.)

**"Effect of Incomplete Cross-linking on the Chemical and Physical Properties of Hardened Polyester Resins,"** J. Fritz, *Kunststoffe*, 47, 12, 710 (Dec. 1957).

The importance of correct curing of polyester resins is illustrated by comparing the properties of polyester resins in which cross-linking is incomplete with those in which the process has been brought to completion. The author discusses the chief factors involved, and gives hints on the precautions to be taken to achieve satisfactory results. (In German.)

**"Conditions of Plastic Deformation in Welding PVC Sheet,"** H. Haldenwanger and W. Berger, *Kunststoffe*, 48, 1, 13 (Jan. 1958).

The welding of PVC sheet represents a process of plastic deformation at high temperature. The strength of the weld depends on temperature, pressure and time during which the two surfaces were pressed together. A device and method to determine the relation of plastic deformation to temperature, time and pressure under specified conditions are described. (In German.)

## Equipment

**"Screw Joints for PVC Pipe,"** W. Schmitt and H. Grothe, *Plaste u. Kautschuk*, 4, 5, 174 (May 1957).

With the aim of producing a compression-screw joint for connecting PVC water pipe to steel pipe that would permit use of the piping immediately after union was effected, a number of designs were tested. The so-called Erfurt and Berlin models proved suitable. These approved models are now being made of grey iron casting, but they have the disadvantages of becoming incrusted and requiring experts to install them. Tests to remove both disadvantages by the use of polyamide, instead of the iron castings, are now in progress. (In German.)

**"Miniature Intensive Mixer,"** M. S. Sheftel and G. E. Berlyn, *Modern Plastics*, 35, 10, 140 (June 1958).

Color dispersions identical to those obtained with large units can be provided by

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in October.

a drill press installation that operates with batches of 15-grams as a tiny mixer.

## Processing

**"Dustless PVC Eases Processing,"** R. S. Holdsworth, W. M. Smith, and J. T. Barry, *Modern Plastics*, 35, 10, 131 (June 1958).

Properties and other data are given for a new family of suspension-polymerized PVC resins that have large, uniform spherical particles, and are processed on conventional equipment.

**"Molding Airplane Models from Reinforced Polyester Resins,"** G. Dixmier and L. Lansac, *Ind. Plastiques Mod.*, 9, 9, 1; 9, 10, 5; and 10, 2, 25 (Nov. & Dec., 1957; Feb. 1958).

The methods for making reinforced polyester models of airplanes and airplane parts for testing in experimental aerodynamics are described in detail. Included are the methods for molding ailerons, fins, and wings; conical transparent component with integral threaded rings of light metal at both ends; models of airplanes designed for exploring the supersonic region in free flight; and very light-weight models for stability tests. (In French.)

**"Molding Linear Polyethylene,"** A. Spaak and C. L. Weir, *Modern Plastics*, 35, 8, 122 (April 1958).

Effects of changes in molding conditions on flow distance into a spiral mold were measured for linear and branched polyethylene and high-impact polystyrene. Results show that linear polyethylene is less sensitive to changes in ram pressures and melt temperature than the other materials. Recommendations are given on cavity cooling; sprue, runner, and gate sizes; and filling rate.

**"Low Pressure Polyethylene Sheet,"** S. Majaro, *Plastics (London)*, 22, 242, 436 (Nov. 1957).

The techniques and tools evolved by the German firm, Farbwerke Hoechst, for fabricating pipe, ducts, extraction fans, and similar industrial items from low-pressure polyethylene are discussed. Modifications in equipment needed for satisfactory forming of sheet are mentioned, and some special applications of the material are listed.

## Applications

**"Plastic Foams,"** K. H. Krause, *Kunststoff Rundschau*, 4, 7, 297 (July 1957).

This review of the various methods of preparing foams from plastic materials

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film casting?
medical plasters?
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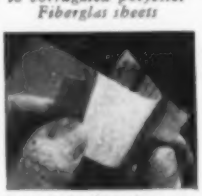

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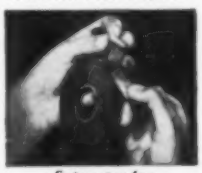

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includes the names of manufacturers of PVC plastisols for foams, raw materials for foams, and of the foamed products, and also a list of various blowing agents, together with their trade names, chemical compositions, and their manufacturers. (In German.)

**"The Use of Elastic Molds in the Processing of Unsaturated Polyester Resins as Casting Resins,"** Schermer, *Plastverarbeiter*, 8, 5, 164 (May 1957).

The use and limitations are discussed of plasticized PVC, gelatine, natural rubber, silicone rubber and a product called Formalose for making molds for polyester casting resins. (In German.)

**"The Use of Vinyl Plastics in Shoemaking,"** T. Shaw, *Rubber & Plastics* Age, 38, 9, 791 (Sept. 1957).

The use of PVC is briefly described in its applications in coated fabrics, combinations with leather, as protective coatings, and in shoe buckles.

**"Plastics at the International Building Exhibition, Berlin 1957,"** A. Schwabe, Kunststoffe, 48, 1, 10 (Jan. 1958).

Plastics in the exhibition buildings and in special exhibits, as well as in various new German and foreign applications, are mentioned. The point is stressed that the problem of facing exterior walls of higher buildings with plastic sheet remains unsolved. The two main difficulties are (1). absolute resistance to light and weathering cannot be guaranteed in all cases; and (2). most products fail to meet official requirements as to non-flammability. (In German.)

**"Use of Reinforced Plastics in Dredging Equipment,"** L. Taal, *Ind. Plastiques Mod.*, 10, 1, 1 (Jan. 1958).

There is a potentially vast field for the use of reinforced plastics in dredging equipment. The difficulties in the way of this application, as experienced by investigators in the Netherlands in attempts to meet official demands for light-weight dredging equipment, are discussed. Among the points dealt with are the theory of reinforcing resistant components, the testing of glass fibers and fabrics, and the calculation of the tensile strengths of glass fiber laminates. The need for careful selection of the appropriate glass fibers is particularly stressed. (In French.)

**"Rigid Urethane Foams,"** M. E. Bailey, and R. C. Kuder, *SPE J.*, 14, 5, 31 (May 1958).

The foams are shown to combine lithness of weight and good insulation properties with sufficient structural strength to make them of interest in building, marine, and transportation applications.

**"Insulative and Conductive Coatings,"** Elbert Davis, *SPE J.*, 14, 5, 19 (May 1958).

A survey of typical properties of resins currently being used for electrical coatings in aircraft.

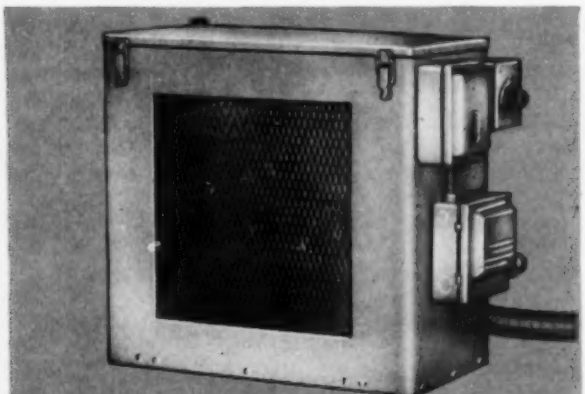
**"Epoxy Resins as Cryogenic Structural Adhesives,"** R. M. McClintock and M. J. Hiza, *Modern Plastics*, 35, 10, 172 (June 1958).

Data are given for various properties of a filled epoxy resin at temperatures down to 20° K. Tensile and shear strengths of copper-to-copper bonds were measured at varying conditions of test, pretest temperature, and bond thickness.

## General

**"The Continental Plastics Industry and Institutes,"** S. Heath, *Rubber & Plastics Age*, 38, 10 866 (Oct. 1957).

The author, senior lecturer in Plastics Technology at the Birmingham College of Technology, reports on a three-months tour of various plants producing plastics materials, products, and processing machinery in Germany, the Netherlands and Switzerland; also, his impressions of educational and research institutes in the first two countries.

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# Patent Digest

## Materials

**Reaction Products of Carboxylated Phenol-Aldehyde Resins and Amine-Modified Phenol-Aldehyde Resins and Process of Making Same.** No. 2,819,240. Melvin De Groote, University City, Mo. (to Petrolite Corp., Wilmington, Del.).

The esterification process involves reacting a carboxylated phenol-aldehyde resin and an amine-modified phenol-aldehyde resin in the molar ratio of 1-4:1.

**Ethylenically Unsaturated Alkyd Resin Copolymerized with N-Vinyl-2-Oxazolidone and Process for Making Same.** No. 2,818,399. Erhart K. Drechsel, Springdale, Conn. (to American Cyanamid Co., New York, N. Y.).

The compound comprises N-vinyl-2-oxazolidone and a polymerizable, unsaturated alkyd resin containing a plurality of polymerizably-reactive alpha, beta-enal groups.

**Polyvinyl Chloride Stabilized with 2-Hydroxy-5-Salicylylbenzophenone.** No. 2,818,401. Warren S. Forster, Somerville, N. J. (to American Cyanamid Co., New York, N. Y.).

In addition to PVC, the composition contains 0.01-5% by weight of 2-hydroxy-5-salicylylbenzophenone.

**Copolymers of Aryl Olefins and Alpha Beta Ethylenically Unsaturated Carboxylic Acid Esters of Oxidized Tall Oil Esters.** No. 2,819,234. Lawrence H. Dunlap, Lancaster Township, and Robert H. Reiff, Lancaster, Pa. (to Armstrong Cork Co., Lancaster, Pa.).

The oxidized, polyhydric alcohol ester of a tall oil having a viscosity of 450-1,500 seconds (Gardner-Holdt) is esterified with an alpha, beta, ethylenically unsaturated carboxylic acid. The resulting ester is copolymerized with a vinyl aromatic compound containing a single vinyl group. Reacting temperatures are in the range of 60-150° C.

**Foamable Resinous Composition Containing Tertiary Alkyl Ammonium Nitrite and Process of Foaming Same.** No. 2,821,513. James S. Strong, Oreland, Pa.

Polymerized vinyl chloride is dispersed in a fluid mixture of plasticizer and a tert-alkyl ammonium nitrite.

**Polymerization of Trifluorochloroethylene.** No. 2,820,027. William E. Hanford, Short Hills, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

The monomer is polymerized in the presence of an organic peroxide catalyst and at least 40% by weight of a perfluorinated tertiary alkyl amine

## Equipment

**Liquid Extractor for Filamentary Material.** No. 2,816,430. Robert R. Smith, Wilmington, Del. (to American Viscose Corp., Philadelphia, Pa.).

Liquid laden filamentary material passes over a rotatable bearing surface whose motion is derived from that of the filament. A pair of opposing flanges, permanently attached to the rotating part, contain enclosed channels which open onto the filamentary material bearing surface. The channels originate at uniformly spaced intervals at the flange centers and extend outwardly to their peripheries. When the unit is rotated, a centrifugal air flow away from the bearing surface is created in the channels. The suction thus formed, removes the liquid from the filamentary material and draws it through the channels.

**Foam Plastic Skiving Machine.** No. 2,821,254. Hans Kernen, Bern, Switzerland.

Foils can be cut off from a foamed plastic sheet with this unit which comprises a sheet-supporting means and an advancing knife with serrated cutting edge. The knife is oscillated longitudinally through the sheet at a frequency which prevents resonation.

**Apparatus for Making One-Piece Hollow Articles of Thermoplastic Material.** No. 2,819,490. Mark L. Froot, New York, N. Y. (to Doralaine Corp., Newark, N. J.).

The apparatus consists of a hollow mandrel; a means for extruding the plastic tube onto the mandrel; a pair of complementary, hollow mold parts; a means for drawing the mold parts around the mandrel; a means for blowing air through the mandrel to expand the tube against the inner surfaces of the hollow mold parts; and a means for opening and closing the mold parts

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

**Prevention of Die-Facing of Thermoplastic Filaments.** No. 2,821,744. James E. Spohn, Norristown, and Floyd E. Wiley, Royersford, Pa. (to Firestone Tire & Rubber Co., Akron, O.).

An apparatus for melt-spinning filaments of thermoplastic resin comprising a multi-orificed die through which fused resin is forced to form an array of filaments. An annular nozzle, adjacent to and concentric with the die directs a jet of air radially inward and upward against its face in the region of filament-emergence.

**Apparatus for Extruding Films.** No. 2,821,746. Leo B. Bicher, Jr., Hackensack, N. J. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

The die has a narrow rectangular orifice, one lip of which is straight while the other has two spaced, bead-forming slots of small cross-section. A revolving drum is located beneath the die and in close proximity to a roll having circumferentially spaced bead-shaping grooves. The roll is adapted to press against a film extruded through the orifice and carried by the drum.

**Dielectric Heat Sealing Apparatus.** No. 2,822,029. Earl J. Hoagland, Chicago, Ill. (to Standard Safety Equipment Co., Chicago, Ill.).

The apparatus includes a press, a source of high frequency electrical energy, and a die arrangement for sealing materials of irregular thickness. The cavity in the die body is covered by a conformable, electrically-conductive portion for directing current through materials inserted between the die and one of the press plates. Controlled fluid pressure causes the conformable portion to exert an even pressure on the materials.

## Processing

**Core Member Insulation.** No. 2,822,483. Milton V. De Jean, Fort Wayne, Ind., and Ivan L. Gray, Scotia, N. Y. (to General Electric Co., Schenectady, N. Y.).

An insulating coating for the end-slots of a dynamo core member consisting of an adhesive base material, and a layer of thixotropic epoxy resin.

**Curing of Epoxide Resins with a Chelate.** No. 2,819,233. Earl L. Smith, and Ralph Hall, Fort Wayne, Ind. (to Phelps Dodge Copper Products Corp., Fort Wayne, Ind.).

A stable amine-epoxy material which can be heat-cured is obtained by adding a soluble, amine-metal organic salt chelate.

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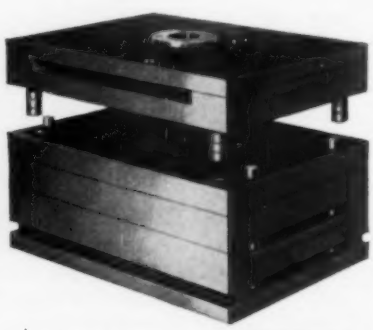

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This latter material is formed through the interaction of diethylene triamine with the organic salt of zinc, cobalt, manganese, or copper.

**Method of Extrusion.** No. 2,820,252. Robert B. Koch, Hyde Park, Pa. (to Polymer Corp., Reading, Pa.).

Molten polyamide is forced through a die which is made of polytetrafluoroethylene filled with silica. The extruded, elongated shapes are directed into a water bath containing a wetting agent.

**Electrodeposition of Tetrafluoroethylene Polymers.** No. 2,820,752. George William Heller, New York, N. Y. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

Wire is coated with substantially-pure polytetrafloroethylene to form a homogeneous, crack-free electrical insulation in the following manner: the wire is passed through a codispersion of polytetrafluoroethylene and polyisobutylene, which is simultaneously subjected to a direct current of electricity. This makes the wire anodic. The wire is removed and dried; then passed through a zone maintained at 300-500° C., for a time sufficient to decompose the polyisobutylene.

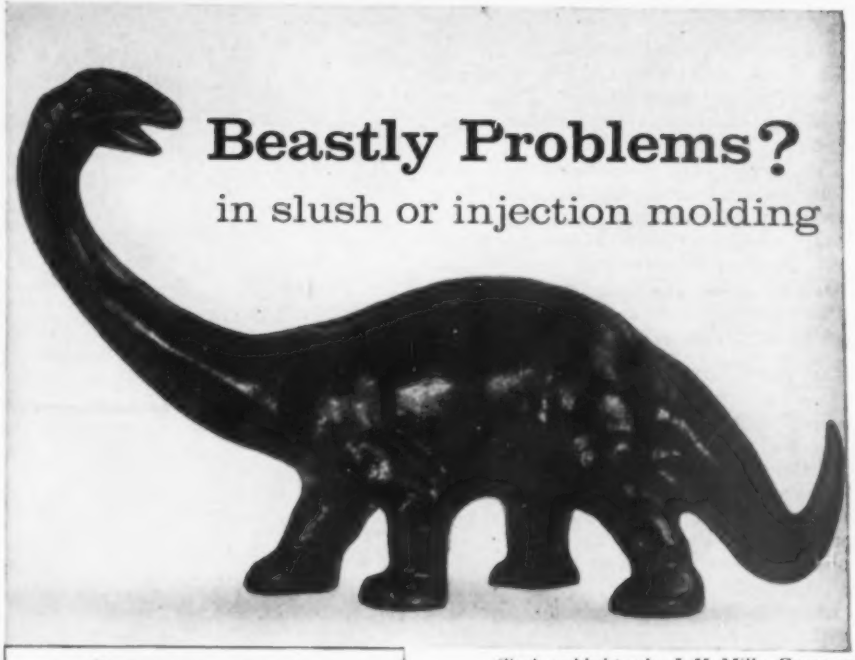
**Process of Coating Metal With Methyl Methacrylate Resin and Product Formed Thereby.** No. 2,823,140. John H. Lowell, Brookline, Pa. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

A metal article having a hard, adherent, multiple-layer coating of pigmented primer in adherent contact with the metal; a layer of undercoat; and a top-coat of methyl methacrylate lacquer. The undercoat is an organic film-forming material consisting of a polymeric phosphate reaction product of phosphoric acid with a copolymer of methyl methacrylate and glycidyl methacrylate.

**Process of Printing an Electrical Circuit on a Chlorinated Polymer, Resultant Article and Printing Ink.** No. 2,823,146. Frederick N. Roberts, New York, N. Y., and Fred W. West, Ridgefield, N. J. (to Minnesota Mining and Mfg. Co., St. Paul, Minn.).

An ink, comprising an admixture of a conductor having a particle size less than 50 microns and a polymer of trifluorochloroethylene, is applied to the surface of the chlorinated polymer. The printed surface is maintained at a temperature between 100-375° C., for not more than 30 minutes.

(*Continued on page 686*)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## Applications

**Improved Plastic Laminate.** No. 2,825,-672. Frank F. Koblitz, Oregon, Wis., and Joan Tinoco, West Haven, Conn. (to Bjorksten Research Laboratories, Inc., Madison, Wis.).

An acrylic base is coated with a synthetic resin adhesive, and laminated to a preformed layer of resin selected from the group consisting of N-hydroxylated nylons, N-alkoxylated nylons, and N-alkenoxylated nylon. The resin layer is covered with a coating consisting of polyepoxide and an acrylic base.

**Vinyl Coated Knit Fabric.** No. 2,823,-156. William D. Hedges, Columbus, O. (to Columbus Coated Fabrics Corp., Columbus, O.).

Knitted fabric is embedded in a performed vinyl sheet having a coating of polymerized vinyl chloride resin, plasticizer, and color pigment. The combination is united to form an integral sheet of material. Ingredients contained in the coating composition include:

| | Parts By Weight |
|---|---|
| Polymerized vinyl chloride resin | 10.0 |
| Clay | 8.0 |
| Di-octyl-phthalate | 6.0 |
| Cadmium octoate | 0.15 |
| Barium laurate | 0.15 |
| Color pigment | 1.0 |
| Mineral spirits | 1.5 |

## CALENDAR of COMING EVENTS

**Aug. 4-8**

1958 Gordon Research Conferences on Elastomers and Polymers. University of Rhode Island. Colby Junior College, New London, N.H.

**Sept. 7-20**

31st Industrial Chemistry Conference of Liege. Federation of Belgian Chemical Industries and the Belgian Branch of the Industrial Chemical Society. Liege, Belgium.

**Sept. 12**

SPE Detroit Section. Regional Technical Conference. Plactics in Automotive Applications. St. Clair Inn, St. Clair, Mich.

**Sept. 22-24**

Seventh Annual Meeting. Standards Engineers Society. Benjamin Franklin Hotel, Philadelphia, Pa.

**Oct. 1**

SPE Western New England Section. Regional Technical Conference. Plastics in Packaging. Hotel Statler, Hartford, Conn.

**Oct. 9-10**

SPI 14th New England Section Conference. Wentworth-by-the-Sea, Portsmouth, N.H.

**Oct. 20-22**

13th Tappi Plastics-Paper Conference. Sheraton-Kimball Hotel, Springfield, Mass.

**Oct. 21**

SPE Upper Midwest Section. Regional Technical Conference. Epoxies. Curtis Hotel, Minneapolis, Minn.

**Nov. 13**

SPE Southern California Section. Regional Technical Conference. Plastics in Building and Construction. Ambassador Hotel, Los Angeles, Calif.


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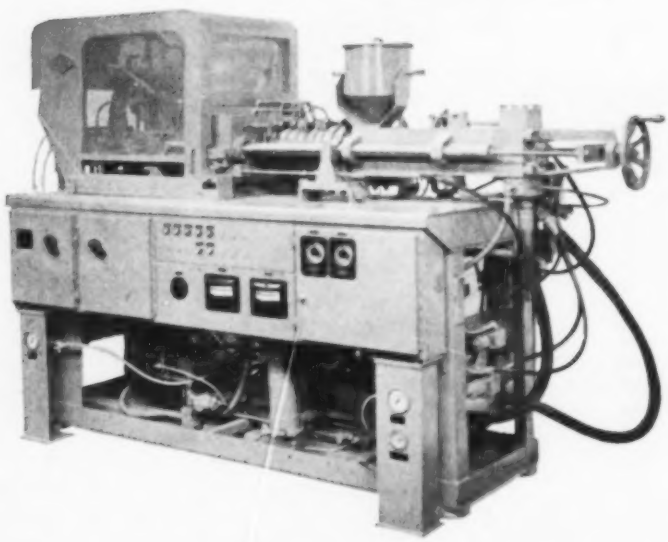

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# Domestic Production and Sales of Plastics and Resin Material, February and March, 1958

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of February and March, 1958. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Although production and sales volumes for nearly all categories are slightly below those of last year, most of the materials have been showing slight but steady increases since January 1. Largest increase occurred in polyethylene resins, which are up nearly 33⅓% over last year's totals for this period.

| | February, 1958 | | March, 1958 | |
|---|---|---|---|---|
| | Production | Sales | Production | Sales |
| Cellulose Plastics[1] | | | | |
| Cellulose acetate and mixed ester: | | | | |
| Sheets, under 0.003 gage | 1,230,072 | 1,225,058 | 1,680,105 | 1,688,241 |
| Sheets, 0.003 gage and over | 1,471,308 | 1,281,589 | 1,490,369 | 1,424,413 |
| All other sheets, rods, and tubes | 581,990 | 662,068 | 652,800 | 733,717 |
| Molding and extrusion materials | 6,677,428 | 6,427,460 | 7,652,829 | 7,493,412 |
| Nitrocellulose sheets, rods, and tubes | 289,763 | 290,594 | 278,414 | 302,070 |
| Other cellulose plastics | 671,334 | 431,609 | 736,046 | 571,778 |
| TOTAL | 10,921,895 | 10,318,378 | 12,490,563 | 12,213,631 |
| Phenolic and Other Tar-Acid Resins: | | | | |
| Molding materials[1] | 13,213,497 | 11,799,337 | 13,781,694 | 12,670,572 |
| Bonding and adhesive resins for— | | | | |
| Laminating (except plywood) | 4,945,921 | 3,198,309 | 5,249,242 | 3,401,328 |
| Coated and bonded abrasives | 972,717 | 889,031 | 1,152,290 | 701,026 |
| Friction materials (brake linings, clutch facings, and similar materials)[7] | 1,016,193 | 1,006,291 | 774,470 | 632,491 |
| Thermal insulation (fiber glass, rock wool) | 3,276,260 | 3,036,720 | 3,118,270 | 3,211,584 |
| Plywood | 3,581,360 | 2,267,731 | 3,840,164 | 3,222,919 |
| All other bonding and adhesive uses | 3,060,380 | 3,098,842 | 2,717,772 | 2,908,125 |
| Protective-coating resins, unmodified and modified except by rosin | 2,368,767 | 1,708,074 | 2,455,347 | 1,668,353 |
| Resins for all other uses | 2,433,822 | 1,666,134 | 2,168,043 | 1,543,171 |
| TOTAL | 34,868,917 | 28,670,469 | 35,257,292 | 29,959,569 |
| Urea and Melamine Resins: | | | | |
| Textile-treating and textile-coating resins | 2,826,741 | 2,803,206 | 2,816,694 | 2,566,138 |
| Paper-treating and paper-coating resins | 2,269,970 | 1,767,854 | 1,952,996 | 1,729,429 |
| Bonding and adhesive resins for— | | | | |
| Plywood | 6,247,320 | 6,611,495 | 7,363,287 | 7,767,420 |
| All other bonding and adhesive uses, including laminating | 2,852,810 | 3,347,984 | 3,444,603 | 3,129,438 |
| Protective-coating resins, straight and modified | 2,090,887 | 1,695,607 | 2,293,155 | 1,634,056 |
| Resins for all other uses, including molding | 7,673,861 | 7,099,502 | 8,323,622 | 7,630,435 |
| TOTAL | 23,961,589 | 23,325,648 | 26,194,357 | 24,456,916 |
| Styrene Resins: | | | | |
| Molding materials[1] | 29,656,232 | 33,427,954 | 32,368,997 | 33,860,563 |
| Protective-coating resins, straight and modified | 7,496,527 | 6,772,902 | 7,458,399 | 7,128,067 |
| Resins for all other uses | 12,559,932 | 9,968,793 | 12,859,318 | 10,224,620 |
| TOTAL | 49,712,691 | 50,169,649 | 52,686,714 | 51,213,250 |
| Vinyl and Vinyl Chloride Resins:[3] | | | | |
| Polyvinyl chloride and copolymer resins (50% or more PVC) for— | | | | |
| Film (resin content) | | 5,901,555 | | 5,588,371 |
| Sheeting (resin content) | | 4,411,752 | | 4,050,114 |
| Molding and extrusion (resin content) | | 13,907,314 | | 14,285,733 |
| Textile and paper treating and coating (resin content)[8] | | 4,468,201 | | 3,566,807 |
| Flooring (resin content) | | 7,964,130 | | 8,522,882 |
| Protective coating (resin content) | | 2,249,691 | | 2,268,455 |
| All other uses (resin content) | | 3,368,879 | | 3,591,162 |
| All other vinyl resins for— | | | | |
| Adhesives (resin content) | | 3,484,361 | | 3,932,771 |
| All other uses (resin content) | | 9,192,989 | | 8,991,996 |
| TOTAL | 58,326,883 | 54,948,872 | 62,326,047 | 54,798,291 |
| Coumarone-Indene and Petroleum Polymer Resins | 18,350,270 | 18,180,119 | 18,290,082 | 18,340,876 |
| Polyester Resins: | | | | |
| For reinforced plastics | 7,197,778 | 6,537,073 | 7,658,291 | 3,653,666 |
| For all other uses | 712,057 | 683,759 | 978,427 | 778,530 |
| TOTAL | 7,909,835 | 7,220,832 | 8,636,718 | 4,432,196 |
| Polyethylene Resins: | | | | |
| For film | | 18,447,516 | | 17,630,553 |
| For all other uses | | 35,932,446 | | 40,249,170 |
| TOTAL | 61,800,790 | 54,379,962 | 64,574,994 | 57,879,723 |
| Miscellaneous Synthetic Plastics and Resin Materials: | | | | |
| Molding materials[1, 4] | 2,921,828 | 3,075,536 | 2,817,471 | 2,781,053 |
| Protective-coating resins[5] | 861,179 | 538,037 | 1,046,460 | 536,257 |
| Resins for all other uses[6] | 10,015,861 | 9,058,947 | 11,538,270 | 9,812,355 |
| TOTAL | 13,798,868 | 12,672,520 | 15,402,201 | 13,129,665 |
| GRAND TOTALS | 279,651,738 | 259,886,449 | 295,858,968 | 266,424,117 |

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7]Included with "All other bonding and adhesive uses."
SOURCE: United States Tariff Commission, Chemical Division.

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# Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear three times a year, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

— The Editor

## Adhesives

| | | |
|---|---|---|
| Ampcoflex Adhesive | gl. | $2.75 / $3.50 |
| Bakelite BC—17613 | lb. | .54 / .84 |
| BCU-40 | lb. | .18 / .48 |
| BR-11938 | lb. | .285 / .585 |
| Bonding resins, abrasives | lb. | .20 / .915 |
| Brake linings | lb. | .215 / .6275 |
| Foundry resins | lb. | .2075 / .395 |
| Heat Insul. resins | lb. | .1425/ .37 |
| CD Cement Nos. 200, 201, 202, 203, 204 | gl. | .94 / 1.50 |
| PS-7 | gl. | 2.12 / 2.90 |
| Dow Corning C-271 | lb. | 1.64 / 1.89 |
| Eccobild 314 | lb. | .95 / 1.20 |
| 318 | lb. | 1.30 / 1.75 |
| Epon Adhesive VI, VIII | lb. | 3.08 / 3.30 |
| IX | lb. | 4.25 / 4.50 |
| Epoxy Adhesive A-1, A-3, A-4 | gl. | 4.45 / 6.90 |
| A-2, A-5 | gl. | 5.60 / 8.00 |
| A-6 | gl. | 5.80 / 8.00 |
| C-1, C-2, C-3, C-9 | gl. | 5.60 / 8.00 |
| C-4, C-7 | gl. | 3.69 / 5.30 |
| Flexible Resin No. 1 | gl. | 4.45 / 6.90 |
| G-E 12316 | lb. | .30 / .39 |
| 12353 | lb. | .225 / .383 |
| Melmac 401 | lb. | .45 |
| 421 | lb. | .45 / .47 |
| Melurac 300, 302 | lb. | .25 / .29 |
| 301 | lb. | .28 / .33 |
| Metlbond 2002-14 | gl. | 1.84 / 5.00 |
| 4021 Type I | sq. ft. | 1.43 |
| Type II | gl. | 1.29 / 3.20 |
| Type III | gl. | 1.49 / 3.50 |
| Plaskon Phenolic Bonding Resin | lb. | .16 / .21 |
| Urea Adhesive 330-11L | lb. | .1875/ .2173 |
| Liquid Adhesive, 2L Types | lb. | .105 / .115 |
| WR Types | lb. | .0675/ .125 |
| Spray Dried Adhesives | lb. | .18 / .29 |
| Plastic Cement | gal. | 2.25 / 2.70 |
| Pliobond 20 | gal. | 4.50 / 7.00 |
| 30 | gal. | 5.25 / 8.00 |
| Polyester Foam Cement FC-232 | gal. | 2.40 / 2.90 |
| Schenectady SP-7401 | lb. | .29 / .31 |
| Schwartz Vinyl Cement | gl. | 1.26 / 1.50 |
| Synvarite US #1 | lb. | .195 / .215 |
| Synvarol T | lb. | .125 / .16 |
| T-3 | lb. | .0875/ .1225 |
| T-15, T-15D | lb. | .1275/ .1625 |
| TN, TUN | lb. | .1325/ .1675 |
| TN-231 | lb. | .14 / .175 |
| WR-513 | lb. | .0875/ .1225 |
| WR-515 | lb. | .0825/ .1175 |
| WR-520 | lb. | .0625/ .0925 |
| Styrofoam Adhesive #5 | gal. | 3.75 / 4.75 |
| Thixon CB | gal. | 3.30 / 3.70 |
| CB-2 | gal. | 3.75 / 3.95 |
| IB | gal. | 3.75 / 4.15 |
| NB | gal. | 4.05 / 4.45 |
| NM-3 | gal. | 7.20 / 8.00 |
| Urac 110 | lb. | .205 / .225 |
| 115 | lb. | .24 / .26 |
| 180 | lb. | .095 / .12 |
| 185 | lb. | .1625/ .2175 |
| 186 | lb. | .0875/ .1125 |
| 192 | lb. | .07 |

## Anti-Static Agents

| | | |
|---|---|---|
| Anstac-2M | gl. | 1.75 / 2.00 |
| Hanson-Van Winkle-Munning PC-19 | lb. | .322 / .402 |
| PC-52 | lb. | .166 / .246 |
| PC-93 | lb. | .288 / .368 |
| Logostat | gal. | 1.35 / 1.65 |
| Merix Anti-Static #79 | gl. | .75 / 3.85 |
| #79-OL | gl. | .75 / 3.85 |

## Catalysts

| | | |
|---|---|---|
| Advance cobalt naphthenate 6% | lb. | $0.4825/ $0.5825 |
| Cobalt tallate 6% | lb. | .4375/ .5375 |
| Advacol | lb. | .4375/ .5375 |
| Aritemp Curing Agent 105 | lb. | 2.00 / 2.25 |
| Bakelite BH-17618 | lb. | .33 / .63 |
| BHU-53 | lb. | .15 / .45 |
| ERL series | lb. | .67 / 1.195 |
| Cadet benzoyl peroxide, granules | lb. | .98 / 2.00 |
| Paste | lb. | .95 / 2.25 |
| Powder | lb. | 1.50 / 2.37 |
| Dichlorobenzoyl peroxide | lb. | 3.00 / 4.25 |
| Lauroyl peroxide | lb. | 1.90 / 3.50 |
| Methyl ethyl ketone peroxide | lb. | 1.85 / 4.00 |
| Catalyst 57 | lb. | .12 |
| 196 | lb. | .10 |
| C-110, -180, -180-S, C-110-S, WF-100, -101 | lb. | .12 |
| Celanese accelerators D & E | lb. | .43 / .50 |
| Benzol peroxide paste | lb. | 2.00 |
| Catalyst MC-1 | lb. | 2.25 / 2.50 |
| Emerson & Cuming Catalyst 209 | lb. | .95 / 4.00 |
| 211 | lb. | 2.25 / 4.50 |
| 217 | lb. | 3.40 / 4.50 |
| Epi-Cure 82 | lb. | .82 / 1.60 |
| 83 | lb. | 1.54 / 2.32 |
| 84 | lb. | 2.94 / 3.72 |
| 85 | lb. | 1.125 / 1.905 |
| 86 | lb. | 1.50 / 2.37 |
| 87 | lb. | .73 / 1.51 |
| Epon Curing Agent $BF_3$-400 | lb. | 4.00 / 4.50 |
| C-111 | lb. | .6225 / 1.10 |
| D | lb. | 3.33 / 4.75 |
| T | lb. | .80 / 1.11 |
| U | lb. | .86 / 1.02 |
| Z | lb. | 1.265 / 1.56 |
| Lucidol Catalysts: Alperox C | lb. | 1.85 / 3.50 |
| Acetyl peroxide, 25% | lb. | 1.75 / 4.00 |
| Benzoyl peroxide, granular | lb. | .98 / 2.00 |
| pastes | lb. | .91 / 3.00 |
| Cyclohexanone peroxide, paste | lb. | 2.25 / 2.50 |
| Di-t-butyl diperphthalate | lb. | 4.75 / 6.50 |
| Peroxide | lb. | 2.00 / 4.00 |
| Hydroxyheptyl peroxide | lb. | 4.50 |
| Methyl ethyl ketone peroxide | lb. | 1.85 / 4.00 |
| p-chlorobenzoyl peroxide | lb. | 2.50 / 3.50 |
| p-menthane hydroperoxide | lb. | .545 / 2.00 |
| t-butyl hydroperoxide | lb. | 2.00 / 3.75 |
| peracetate | lb. | 4.00 / 6.00 |
| perbenzoate | lb. | 3.00 / 4.75 |
| 2, 4, dichlorobenzoyl peroxide | lb. | 2.90 / 6.00 |
| 2, 5-dimethylhexane-2, 5-dihydroperoxide | lb. | 5.00 |
| Furane H-736-A | lb. | 1.30 / 2.00 |
| Marblette Hardener 11 | lb. | 1.17 / 1.65 |
| 16, 661, 680 | lb. | 1.25 / 1.70 |
| 20 | lb. | 1.17 / 1.40 |
| 21 | lb. | 1.27 / 1.40 |
| 41, 665 | lb. | 1.32 / 1.77 |
| 175, 179 | lb. | .50 / .65 |
| 645H | lb. | 1.15 / 1.70 |
| 681, 901 | lb. | 1.20 / 1.80 |
| 900, 903 | lb. | 2.10 / 2.50 |
| H C Promoter 6% | lb. | .5275/ .6275 |
| 12% | lb. | .9025/ 1.0025 |
| Het anhydride | lb. | .55 |
| HN 551 | lb. | .95 / 1.40 |
| 901 | lb. | .36 / .80 |
| 951 Ciba | lb. | .82 / 1.32 |
| 951 Furane | lb. | 1.30 / 2.00 |
| IC activators | | $3.00 |
| Inhibitor | lb. | .98 |
| Melurac 255, 259 | lb. | .35 |
| Modifier CB-110, WF-61 | lb. | .15 |
| P-27 | gal. | 10.00 |
| Plaskon Hardeners, Liquid | lb. | .07 |
| Powdered | lb. | .10 / $0.46 |
| Spray dried | lb. | .10 / .25 |
| Promoter D-2 | lb. | 1.60 / 2.00 |
| Quick-Set Accelerator 804 | gal. | 9.80 |
| Reichhold Hardeners 2600, 2601, 2602, 2603, 2604 | lb. | .80 / 1.58 |
| Resolin epoxy hardeners | lb. | 1.14 / 2.50 |
| HN-951 | lb. | 0.86 / 1.74 |
| SA Hardener | lb. | .10 |
| Sealset 701 | gal. | 20.00 / 22.00 |
| 702 | gal. | 9.20 / 10.00 |
| 703 | gal. | 18.00 / 19.20 |
| Soligen | lb. | .4825/ .58/5 |

## Coating Resins

| | | |
|---|---|---|
| Acme 150, 160 | lb. | 2.00 / 2.50 |
| Dispersant A | lb. | .75 / 1.00 |
| Acryloids | lb. | .30 / .87 |
| Amberlacs | lb. | .2625/ .2875 |
| Amberols, phenolic types | lb. | .2125/ .375 |
| Rosin maleic types | lb. | .21 / .345 |
| Bakelite Phenolics | lb. | .28 / .64 |
| Styrene emulsions | lb. | .1375/ .31 |
| Vinyl acetates | lb. | .295 / .66 |
| Solutions | gal. | 5.10 |
| Alcohols | gal. | 2.27 / 2.76 |
| Butyral resins | lb. | 1.04 / 1.24 |
| Chlorides | lb. | .41 / .61 |
| Chloride-acetates | lb. | .38 / .66 |
| Modified | lb. | .44 / .72 |
| Celanese PVA emulsions, homopolymers | lb. | .17 / .26 |
| Copolymers | lb. | .19 / .28 |
| Chemigum latices | lb. | .46 / .60 |
| Cymel 243-8 | lb. | .38 / .385 |
| 245-8 | lb. | .34 / .345 |
| 247-10 | lb. | .385 / .39 |
| 248-8 | lb. | .365 / .37 |
| Dow Corning 805, 808 | lb. | 1.54 / 1.65 |
| 806 | lb. | 1.85 / 1.98 |
| 840 | lb. | 1.52 / 1.73 |
| Dylex K-500, -600, -700, -900 | lb. | .30 / .46 |
| G-E 13110 | lb. | .30 / .39 |
| Kel-F Dispersion (dry wt.) | lb. | 12.00 |
| Ladcote FHHF-4010, FYHF-4010 | lb. | .3575/ .4075 |
| Plaskon Alkyds | lb. | .1075/ .3375 |
| Modified | lb. | .15 / .2625 |
| Ester Gums | lb. | .1425/ .2475 |
| Maleics | lb. | .1825/ .275 |
| Melamines | lb. | .195 / .435 |
| Phenolics | lb. | .3925/ .475 |
| Modified | lb. | .1825/ .29 |
| Phenolic Laminating Varnishes | lb. | .165 / .27 |
| Silicone Alkyds | lb. | 1.10 / 2.40 |
| Ureas | lb. | .195 / .435 |
| Pliolite latices | lb. | .30 / .39 |
| Pliolite N R | lb. | .93 / 1.22 |
| S-3 | lb. | .42 / .44 |
| S-5 | lb. | .49 / .51 |
| Milled | lb. | .54 / .56 |
| S-7 | lb. | .88 / 1.01 |
| Polyfluoron liquid dispersions | lb. | 2.65 / 3.85 |
| Paste dispersions | lb. | 4.20 / 4.40 |
| Primer 140 | gl. | 7.88 / 8.25 |
| Reichhold Coating Resins: Beckacite, floor covering | lb. | .2175/ .2575 |
| Modified phenolic | lb. | .1975/ .2475 |
| Non-phenolic | lb. | .215 / .3175 |
| Super, pure phenolic | lb. | .2925/ .5825 |
| Beckamine U-F | lb. | .1975/ .35 |
| Super, melamine | lb. | .3275/ .397 |
| Beckolin | lb. | .2225/ .355 |
| Beckopol | lb. | .2525/ .2625 |
| Beckosol Solutions, epoxy esters | lb. | .37 / .40 |
| Modified | lb. | .18 / .23 |
| Non-phthalic | lb. | .16 / .2325 |
| Phenolated | lb. | .16 / .2425 |
| Pure-drying | lb. | .1525/ .28 |
| Non-drying | lb. | .205 / .295 |
| Super, isophthalic | lb. | .2075/ .3025 |
| Epoxy resin | lb. | .595 / .6975 |
| Hard resin solutions | lb. | .115 / .195 |
| Hydrogum | lb. | .17 / .245 |
| Kopol | lb. | .2675/ .2725 |
| Pentacite, non-phenolic | lb. | .17 / .2425 |
| Piyophen phenolics, alcohol-soluble | lb. | .17 / .725 |
| Liquid resins | lb. | .165 / .20 |
| Powdered | lb. | .30 / .325 |
| Solution | lb. | .2575/ .2875 |
| Water-soluble | lb. | .111 / .30 |
| Resin emulsions, alkyd | lb. | .23 / .27 |
| Wallpol | lb. | .17 / .23 |
| Styresol | lb. | .2075/ .2475 |
| Synthe-Copal | lb. | .1625/ .20 |
| Wallkyd | lb. | .12 / .195 |
| Schenectady Alkyds SA Type | lb. | .3575/ .38 |
| SE Type | lb. | .3675/ 1.435 |
| SEA Type | lb. | .3575/ .38 |
| Styrenated | lb. | .22 / .2625 |
| Maleics | lb. | .1725/ .23 |

| | | | |
|---|---|---|---|
| Phenolics | lb. | $0.2325/ | $0.535 |
| Modified | lb. | .1825/ | .27 |
| Schwartz AT-25 | gl. | .63 / | 1.00 |
| BK-40 | gal. | 3.80 / | 3.95 |
| Versamid 100 | lb. | .51 / | .69 |
| 115 | lb. | .64 / | .82 |

## Colors

| | | | |
|---|---|---|---|
| **Acheson 0100 Series Paste Dispersions:** | | | |
| Blacks | lb. | .50 / | .81 |
| Blues | lb. | .55 / | 2.175 |
| Green | lb. | 2.51 / | 2.69 |
| Orange | lb. | .67 / | .85 |
| Reds | lb. | 1.08 / | 1.34 |
| White | lb. | .52 / | .70 |
| Yellows | lb. | .57 / | .75 |
| Advabrite M-10 | lb. | 2.25 / | 2.40 |
| Advance Brightener M.D.A.C. | lb. | 12.00 / | 15.00 |
| **Akron Chemical Colors:** | | | |
| Dry blends, reds | lb. | 1.08 / | 1.23 |
| Yellows | lb. | .58 / | .88 |
| Organic colors, blues | lb. | .75 / | 3.60 |
| Greens | lb. | 1.35 / | 3.95 |
| Reds | lb. | 1.10 / | 4.40 |
| Yellows | lb. | 2.00 / | 5.00 |
| Pastes, blues | lb. | 1.25 / | 1.58 |
| Greens | lb. | 1.85 / | 1.90 |
| Reds | lb. | 1.10 / | 1.40 |
| White | lb. | .55 / | .60 |
| Yellows | lb. | 1.70 / | 1.75 |
| **Cabot carbon blacks:** | | | |
| Black pearls 2 | lb. | .70 / | .78 |
| 71 | lb. | .32 / | .40 |
| 74 | lb. | .24 / | .32 |
| 81 | lb. | .084 / | .135 |
| 0 | lb. | .12 / | .19 |
| Carbolac 2 | lb. | .70 / | .79 |
| Elf 0 | lb. | .12 / | .19 |
| Elftex 3, 5, 8 | lb. | .085 / | .135 |
| Monarch 71 | lb. | .32 / | .40 |
| 74 | lb. | .24 / | .32 |
| 81 | lb. | .095 / | .16 |
| Sterling R | lb. | .0525/ | .0925 |
| S | lb. | .045 / | .0875 |
| Supercarbovar | lb. | .47 / | .54 |
| **Cadmolith Reds** | lb. | 1.72 / | 2.20 |
| Yellows | lb. | 1.12 / | 1.20 |
| **California Ink, P. C. color dispersions:** | | | |
| Black | lb. | .76 / | .77 |
| Blues | lb. | .90 / | 2.17 |
| Brown | lb. | .56 / | .57 |
| Green | lb. | 2.05 / | 2.06 |
| Reds | lb. | .61 / | 2.67 |
| White | lb. | .72 / | .73 |
| Yellows | lb. | .62 / | .74 |
| **P. C. plasticized boat colors:** | | | |
| Black | lb. | .76 / | .77 |
| Blue | lb. | 1.32 / | 1.33 |
| Blue-green | lb. | 1.21 / | 1.22 |
| Green | lb. | 2.12 / | 2.13 |
| Red | lb. | 2.69 / | 2.70 |
| Yellow | lb. | 1.71 / | 1.71 |
| **Carbic Colors:** | | | |
| Permanent Carmine FBB | lb. | 6.16 | |
| Red FGR | lb. | 3.07 | |
| Yellow GR | lb. | 3.50 | |
| PV-Carmine B | lb. | 5.40 | |
| PV-Carmine HR | lb. | 6.50 | |
| PV-Fast Orange GRL | lb. | 27.27 | |
| PV-Fast Red B | lb. | 28.00 | |
| PV-Fast Violet BL | lb. | 16.50 | |
| PV-Fast Yellow HR | lb. | 5.10 | |
| PV-Orange G | lb. | 3.30 | |
| PV-Red G | lb. | 4.27 | |
| PV-Violet G | lb. | 13.60 | |
| PV-Yellow G | lb. | 4.46 | |
| PV-Yellow GG | lb. | 4.00 | |
| **Claremont 4000-Series Pastes:** | | | |
| Blacks | lb. | .82 / | 1.01 |
| Blue | lb. | .80 | |
| Browns | lb. | .65 / | 2.30 |
| Greens | lb. | .80 / | 2.15 |
| Orange | lb. | 1.58 | |
| Reds | lb. | 5.60 / | 6.95 |
| Silver | lb. | 1.02 | |
| White | lb. | .715 | |
| Yellows | lb. | .65 / | 2.87 |
| **D-Series pastes,** | | | |
| Blacks | lb. | .48 / | .64 |
| Blues | lb. | .62 / | 1.57 |
| Browns | lb. | .48 / | 1.67 |
| Golds | lb. | 2.31 / | 2.49 |
| Green | lb. | 1.78 / | 1.88 |
| Oranges | lb. | .71 / | 4.27 |
| Reds | lb. | 1.10 / | 6.36 |
| Silver | lb. | .89 / | .91 |
| Whites | lb. | .47 / | .60 |
| Yellows | lb. | .56 / | 3.70 |
| **K-Series pastes,** | | | |
| Blacks | lb. | .56 / | .71 |
| Blues | lb. | .89 / | 1.40 |
| Browns | lb. | .53 / | .55 |
| Greens | lb. | .92 / | 1.41 |
| Metallics | lb. | .89 / | 2.47 |
| Orange | lb. | .86 / | 4.45 |
| Reds | lb. | .99 / | 6.85 |
| Violets | lb. | 2.28 / | 2.30 |
| Whites | lb. | .59 / | .60 |
| Yellows | lb. | .72 / | 3.02 |
| **Maxiprint Series Inks:** | | | |
| Black | lb. | $0.50 / | $0.53 |
| Blues | lb. | .68 / | 1.50 |
| Greens | lb. | .68 / | 1.10 |
| Metallics | lb. | .67 / | 1.20 |
| Orange | lb. | .71 / | .74 |
| Red | lb. | .84 / | 1.13 |
| Violet | lb. | 1.18 / | 1.21 |
| White | lb. | .51 / | .54 |
| Yellows | lb. | .65 / | .68 |
| **MB-Series inks:** | | | |
| Black | lb. | .85 | |
| Blue | lb. | 1.25 | |
| Clears | lb. | .65 / | .66 |
| Green | lb. | 1.30 | |
| Metallics | lb. | 1.20 / | 1.25 |
| Orange | lb. | 1.05 | |
| Pearl | lb. | 1.17 | |
| Red | lb. | 1.11 | |
| White | lb. | .68 | |
| Yellows | lb. | .90 / | 1.23 |
| **MY Series inks:** | | | |
| Black | lb. | .70 | |
| Blue | lb. | 1.25 | |
| Clears | lb. | .57 / | .62 |
| Green | lb. | 1.35 | |
| Greengold | lb. | 1.90 | |
| Orange | lb. | .85 | |
| Pearlescent | lb. | 1.95 | |
| Reds | lb. | 1.15 / | 2.95 |
| White | lb. | .55 | |
| Yellows | lb. | .75 / | 1.35 |
| **Mylar printing inks:** | | | |
| Aluminum | lb. | .99 | |
| Black | lb. | .81 | |
| Blue | lb. | 1.18 | |
| Bronze reducing clear | lb. | .51 | |
| Gold concentrate | lb. | 1.07 | |
| Green | lb. | 1.27 | |
| Hi-viscosity clear | lb. | .69 | |
| Orange | lb. | .97 | |
| Pearlescent concentrate | lb. | 1.98 | |
| Red | lb. | 1.19 | |
| Reducing clear | lb. | .68 | |
| White | lb. | .53 | |
| Yellows | lb. | .83 / | 1.21 |
| **PE-Series, granular concentrates:** | | | |
| Blacks | lb. | .86 / | 1.05 |
| Blues | lb. | 2.98 | |
| Green | lb. | 3.00 | |
| Metallics | lb. | 1.27 / | 1.66 |
| Oranges | lb. | 1.12 / | 2.75 |
| Reds | lb. | 1.93 / | 5.25 |
| Whites | lb. | .70 / | .85 |
| Yellows | lb. | .78 / | 5.10 |
| **PX-Series pastes:** | | | |
| Blacks | lb. | 1.58 / | 2.15 |
| Blues | lb. | 1.15 / | 2.60 |
| Browns | lb. | 1.08 / | 1.47 |
| Green | lb. | 2.76 / | 2.86 |
| Grey | lb. | 1.30 / | 1.40 |
| Metallic, silver | lb. | 1.45 / | 1.55 |
| Orange | lb. | 1.48 / | 1.58 |
| Reds | lb. | 2.25 / | 3.95 |
| White | lb. | .92 / | 1.02 |
| Yellows | lb. | 2.05 / | 2.55 |
| **RP-Series inks:** | | | |
| Aluminum | lb. | .89 | |
| Black | lb. | .58 | |
| Blue | lb. | 1.08 | |
| Gold | lb. | .95 | |
| Green | lb. | 1.12 | |
| Orange | lb. | .83 | |
| Pearlescent | lb. | 1.87 | |
| Red | lb. | 1.08 | |
| Reducing clears | lb. | .47 / | .65 |
| White | lb. | .49 / | |
| Yellows | lb. | .71 / | 1.09 |
| **UR-Series pastes:** | | | |
| Black | lb. | 1.00 | |
| Blue | lb. | 1.82 | |
| Brown | lb. | 2.00 | |
| Green | lb. | 2.20 | |
| Orange | lb. | 1.68 | |
| Reds | lb. | 1.92 / | 3.55 |
| White | lb. | .83 | |
| Yellows | lb. | 1.75 / | 2.15 |
| **VC-Series Inks:** | | | |
| Black | lb. | .56 | |
| Blue | lb. | .68 / | 1.15 |
| Clear | lb. | .39 / | .55 |
| Green | lb. | 1.155 | |
| Metallics | lb. | .72 / | 1.54 |
| Orange | lb. | .68 | |
| Pearl | lb. | 1.96 | |
| Red | lb. | 1.17 | |
| White | lb. | .37 | |
| Yellows | lb. | .61 | |
| **VC-Series Inks, arc resistant:** | | | |
| Black | lb. | .68 | |
| Blues | lb. | .79 / | 1.05 |
| Clears | lb. | .51 / | .53 |
| Greens | lb. | .80 / | 1.17 |
| Metallics | lb. | .74 / | 1.37 |
| Orange | lb. | .81 | |
| Reds | lb. | 1.08 | |
| Violet | lb. | .96 | |
| White | lb. | .54 | |
| Yellows | lb. | .69 / | 1.15 |
| **Columbian Carbon colors:** | | | |
| Aqueous dispersions | | | |
| Aquablak No. 1 | lb. | .20 / | .21 |
| 3 | lb. | .125 / | .135 |
| 15 | lb. | .115 / | .125 |
| 26 | lb. | .1025/ | .1125 |
| 41 | lb. | .34 / | .35 |
| B | lb. | .0975/ | .1075 |
| G | lb. | $0.12 / | $0.13 |
| H | lb. | .23 / | .24 |
| K | lb. | .12 / | .13 |
| L | lb. | .14 / | .15 |
| M | lb. | .11 / | .12 |
| S | lb. | .12 / | .13 |
| U | lb. | .23 / | .24 |
| X | lb. | .11 / | .12 |
| Coloidex No. 3 | lb. | .14 / | .21 |
| No. 8 | lb. | .16 / | .23 |
| Hiblak AB | lb. | .10 / | .11 |
| **Colloidal dispersions** | | | |
| Coacetateblak CQ-21 | lb. | .875 / | .90 |
| Coblac 405 | lb. | .90 / | .925 |
| DD Sol | lb. | .70 / | .725 |
| Industrial | lb. | .73 / | .755 |
| Coethioblak CK | lb. | 1.03 / | 1.055 |
| Coresinblak No. 3 | lb. | .76 / | .785 |
| Costyreneblak 903 | lb. | .595 / | .62 |
| CJ-21 | lb. | .5425/ | .5675 |
| Covarnishblak AR | lb. | .6475/ | .6725 |
| BK | lb. | .565 / | .59 |
| BJ | lb. | .52 / | .545 |
| Covinylblak BA | lb. | .95 / | .975 |
| BD | lb. | .97 / | .995 |
| BF | lb. | .70 / | .725 |
| BH | lb. | .66 / | .685 |
| BL | lb. | .82 / | .845 |
| BM | lb. | .77 / | .795 |
| CA-18 | lb. | 1.0725/ | 1.0975 |
| Cowaxblak BV-25 | lb. | .515 / | .54 |
| CB-18 | lb. | .6225/ | .6475 |
| CM-83 | lb. | .485 / | .51 |
| DC Globak | lb. | .80 / | .825 |
| DCY Coblac | lb. | .83 / | .855 |
| Mapico colors, black | lb. | .1475/ | .15 |
| Browns | lb. | .1575/ | .16 |
| Crimsons, reds | lb. | .1425/ | .145 |
| Tans | lb. | .2325/ | .235 |
| Yellows | lb. | .12 / | .1275 |
| **Electronic Grades:** | | | |
| 110-2, EG-80 | lb. | .1425/ | .145 |
| EG-1, EG-2 | lb. | .2325/ | .235 |
| EG-3 | lb. | .1575/ | .16 |
| **Paint Grades** | | | |
| 140 | lb. | .1025/ | .18 |
| 999 | lb. | .26 / | .34 |
| Excelsior | lb. | .135 / | .21 |
| Molacco | lb. | .0625/ | .125 |
| Beads | lb. | .575 / | .115 |
| Neo Spectra MK. 1 | lb. | .98 / | 1.07 |
| MK. 11 | lb. | .78 / | .87 |
| MK. 111 | lb. | .47 / | .55 |
| Ravens 11 & 15 | lb. | .1025/ | .18 |
| Beads | lb. | .0975/ | .17 |
| Royal Spectra | lb. | 1.66 / | 1.78 |
| Statex | lb. | .0725/ | .13 |
| Beads | lb. | .0625/ | .12 |
| Super Spectra | lb. | .70 / | .79 |
| Superba | lb. | .36 / | .44 |
| Continex HAF | lb. | .0725/ | .13 |
| SRF | lb. | .0525/ | 11 |
| **Cyanamid inorganic pigments:** | | | |
| Cobalt blues | lb. | .28 / | .35 |
| Chrome greens | lb. | .42 / | .44 |
| Oranges | lb. | .35 | |
| Yellows | lb. | .35 | |
| Iron blues | lb. | .52 / | .59 |
| Molybdate chrome oranges | lb. | .48 | |
| Ultramarine blues | lb. | .17 / | .33 |
| Zinc yellow | lb. | .29 | |
| Powders, Unitane-O | lb. | .255 / | .265 |
| Unitane-OR | lb. | .275 / | .285 |
| **Organic dyes, Indulines** | lb. | .89 / | 1.07 |
| Nigrosines | lb. | .65 / | .94 |
| Oil-soluble black | lb. | .68 | |
| Blue | lb. | 8.02 | |
| Orange | lb. | 1.06 | |
| Reds | lb. | 1.49 / | 2.28 |
| Yellows | lb. | 1.21 / | 4.16 |
| Spirit-soluble black | lb. | 2.95 | |
| Brown | lb. | 5.30 | |
| Orange | lb. | 5.87 | |
| Red | lb. | 6.41 | |
| Yellows | lb. | 4.62 / | 4.94 |
| Pigments, alkali blues | lb. | 2.38 | |
| Benzidine oranges | lb. | 3.30 | |
| Yellows | lb. | .69 / | 3.40 |
| Bon reds | lb. | 1.50 / | 2.00 |
| Carteret red | lb. | .98 | |
| Chlorinated para reds | lb. | 1.36 | |
| Clarion orange | lb. | 1.65 | |
| Red | lb. | 1.35 | |
| Dinitraniline oranges | lb. | 1.56 | |
| Fugitive peacock-blue lakes | lb. | 1.00 / | 1.27 |
| Hansa yellows | lb. | 3.20 | |
| Lithol reds | lb. | .98 / | 1.03 |
| Methyl violet base toner | lb. | 1.76 | |
| | lb. | 1.35 | |
| Naphthol reds | lb. | .80 / | .85 |
| Oil orange, Y-239 | lb. | 1.70 | |
| Orange lakes | lb. | .85 / | .90 |
| PTMA blue | lb. | 5.55 | |
| Greens, Lincoln | lb. | 5.30 / | 6.60 |
| Violet | lb. | 4.35 | |
| Para reds | lb. | 1.15 / | 1.21 |
| Phloxine toner | lb. | 1.85 | |
| Phthalocyanine blues | lb. | .90 / | 3.80 |
| Greens | lb. | 3.50 / | 3.95 |
| Pigment green | lb. | 1.35 | |
| Scarlet | lb. | 1.65 | |
| Red Lake C's | lb. | 1.25 | |
| Madder | lb. | 3.10 | |
| Rhodamines | lb. | 6.60 | |
| Toluidine reds | lb. | 1.70 | |
| Yellow lakes | lb. | 1.22 | |

| | | | |
|---|---|---|---|
| **Eagle-Picher Basic carbonate** | | | |
| White lead | lb. | $0.19 / | $0.20 |
| **Basic silicate, white lead** | | | |
| 201 | lb. | .2075/ | .2175 |
| 202 | lb. | .20 / | .21 |
| **Litharge** | lb. | .19 | |
| Sublimed | lb. | .1910 | |
| **Ferro inorganic colors:** | | | |
| Black | lb. | 1.25 / | 1.40 |
| Blues | lb. | 1.91 / | 2.96 |
| Blue-greens | lb. | 1.85 / | 2.85 |
| Browns | lb. | .90 / | 1.31 |
| Oranges | lb. | 2.29 / | 4.20 |
| Pink | lb. | 1.77 / | 1.92 |
| Reds | lb. | 2.96 / | 4.75 |
| Violets | lb. | 1.89 / | 2.37 |
| Yellows | lb. | 1.26 / | 2.90 |
| **Harwick Stan-Tones, blues** | | | |
| Dry | lb. | .90 / | 3.45 |
| GPE | lb. | 2.50 / | 2.85 |
| MBS | lb. | 2.20 / | 4.55 |
| PC | lb. | 1.80 / | 1.92 |
| **Greens, dry** | lb. | .82 / | 3.95 |
| GPE | lb. | 1.60 / | 3.00 |
| MBS | lb. | 1.55 / | 3.42 |
| PC | lb. | 2.20 / | 2.32 |
| **Oranges, cadmium dry** | lb. | 2.10 / | 4.68 |
| Paste | lb. | 2.50 / | 3.18 |
| GPE | lb. | 1.20 / | 1.27 |
| MBS | lb. | 1.25 / | 2.75 |
| PC | lb. | .75 / | .80 |
| **Reds, cadmium dry** | lb. | 2.10 / | 5.52 |
| Paste | lb. | 3.25 / | 3.63 |
| Dry | lb. | .98 / | 4.60 |
| GPE | lb. | .69 / | 3.15 |
| MBS | lb. | 1.00 / | 3.25 |
| PC | lb. | 1.40 / | 2.45 |
| **Yellows, cadmium dry** | lb. | 2.80 / | 3.18 |
| Paste | lb. | 1.77 / | 1.89 |
| Dry | lb. | .69 / | 2.55 |
| GPE | lb. | .69 / | 3.25 |
| MBS | lb. | 1.30 / | 2.20 |
| PC | lb. | .55 / | 3.40 |
| **Hiblak AR** | lb. | .095 / | .10 |
| **Huber pigments:** | | | |
| WVEX, EPC | lb. | .0725/ | .135 |
| Zeolex 7 | lb. | .085 / | .095 |
| 23 | lb. | .06 / | .07 |
| **Interchemical IC Series** | | | |
| Black | lb. | .56 | |
| Blues | lb. | .75 / | 2.10 |
| Browns | lb. | .64 / | .69 |
| Greens | lb. | .90 / | .99 |
| Oranges | lb. | .78 / | .89 |
| Reds | lb. | 1.16 / | 2.50 |
| White | lb. | .70 | |
| Yellows | lb. | .95 / | 1.65 |
| **Kentucky Inorganics** | | | |
| Orange | lb. | .44 / | .64 |
| Yellows | lb. | .31 / | .66 |
| **Organics,** | lb. | 3.00 / | 4.15 |
| Greens | lb. | 3.50 / | 4.60 |
| Purple | lb. | 1.85 / | 2.05 |
| Reds | lb. | 1.95 / | 3.85 |
| **Kriegr-O-Dip W Types** | gl. | 2.63 / | 7.80 |
| A Types | gl. | 1.52 / | 2.25 |
| **Laminac color pastes** | lb. | .76 / | 1.90 |
| **Mearlmaid Pearls** | lb. | 14.00 / | 25.00 |
| **Nacromer Pearls, Series C** | lb. | 2.15 / | 2.25 |
| Series W | lb. | 1.50 / | 1.60 |
| **Plastics Color Co., GP colors:** | | | |
| Blacks | lb. | .75 / | 3.80 |
| Blues | lb. | .445 / | .48 |
| Brown | lb. | 1.20 / | 2.25 |
| Greens | lb. | .65 / | 3.50 |
| Reds | lb. | .65 / | 3.50 |
| Whites | lb. | .75 / | 1.10 |
| Yellows | lb. | 1.15 / | 1.95 |
| Dispersant 3000 | lb. | .50 / | .70 |
| 3005 | lb. | .40 / | .60 |
| 3007 | lb. | .80 / | 1.00 |
| 3008 | lb. | .55 / | .75 |
| **Special acrylic pastes:** | | | |
| Aqua. Ivory | lb. | 1.15 | |
| Black | lb. | 1.90 | |
| Blues | lb. | 1.10 / | 1.25 |
| Brown, White | lb. | 1.05 | |
| Green | lb. | 1.55 | |
| Grey, Pink | lb. | 1.25 | |
| Red | lb. | 2.45 | |
| Yellow | lb. | 1.50 | |
| **Transparent acrylic pastes:** | | | |
| Amber | lb. | 1.60 | |
| Green | lb. | 1.80 | |
| Red | lb. | 1.95 | |
| Violet | lb. | 2.00 | |
| Yellow | lb. | 1.50 | |
| **Polyester pastes, aqua** | lb. | 1.65 | |
| Beige | lb. | 1.45 | |
| Black | lb. | 1.10 | |
| Blues | lb. | 1.20 / | 1.30 |
| Brown | lb. | 1.35 | |
| Greens | lb. | 1.20 / | 1.70 |
| Grey | lb. | 1.30 | |
| Ivory | lb. | 1.30 | |
| Oranges | lb. | 1.80 / | 2.05 |
| Red | lb. | 2.35 | |
| White | lb. | .80 | |
| Yellow | lb. | 1.60 | |
| **Pliolite S-5 bases with pigment** | | | |
| Blacks | lb. | .44 / | .49 |
| Blues | lb. | .62 / | 1.48 |
| Greens | lb. | .54 / | .58 |
| Oranges | lb. | .61 / | .63 |
| Reds | lb. | .31 / | 1.20 |
| Whites | lb. | .42 / | .44 |
| Yellows | lb. | .43 / | .45 |
| **PMS polyester colors** | lb. | .85 / | 2.85 |
| Polystyrene colors | lb. | .65 / | 4.30 |
| **Polysupra polyethylene** | | | |
| blues | lb. | $0.65 / | $05.60 |
| Blacks | lb. | .50 / | .80 |
| Browns | lb. | 1.48 / | 3.30 |
| Greens | lb. | 1.82 / | 3.55 |
| Ivory | lb. | .65 / | 1.00 |
| Purples | lb. | 2.10 / | 3.30 |
| Reds | lb. | .70 / | 6.30 |
| Silver | lb. | 1.50 / | 2.95 |
| White | lb. | .60 / | .85 |
| Yellow | lb. | 1.45 / | 4.25 |
| **Polystyrene blues** | lb. | .50 / | 9.20 |
| Blacks | lb. | .50 / | 5.30 |
| Browns | lb. | .95 / | 2.55 |
| Greens | lb. | .35 / | 7.40 |
| Ivory | lb. | .85 / | 1.20 |
| Reds | lb. | .35 / | 6.40 |
| White | lb. | .60 / | 1.05 |
| Yellows | lb. | 1.45 / | 2.95 |
| **R-B-H Pigment Dispersions:** | | | |
| Blacks | lb. | .66 / | .84 |
| Blues, phthalocyanines | lb. | 2.74 / | 2.84 |
| Browns | lb. | .82 / | .92 |
| Greens, chrome | lb. | .82 / | .92 |
| Phthalocyanines | lb. | 2.35 / | 2.45 |
| Orange | lb. | .83 / | .93 |
| Red | lb. | 1.88 / | 1.98 |
| Whites | lb. | .67 / | .81 |
| Yellow | lb. | .77 / | .87 |
| **Resin Plasticizer Pastes:** | | | |
| Blacks | lb. | .52 / | .695 |
| Blue | lb. | 1.65 / | 1.67 |
| Green | lb. | 1.64 / | 1.66 |
| Orange | lb. | .64 / | .71 |
| Reds | lb. | 1.27 / | 2.06 |
| White | lb. | .51 / | .53 |
| Yellows | lb. | .51 / | .59 |
| **Vinyl Extrusion Chips:** | | | |
| Blacks | lb. | .895 / | 1.09 |
| Blues, iron | lb. | 1.03 / | 1.13 |
| Phthalocyanine | lb. | 2.45 / | 2.55 |
| Brown | lb. | .83 / | .93 |
| Green, chrome | lb. | .91 / | 1.01 |
| Phthalocyanine | lb. | 2.46 / | 2.56 |
| Oranges | lb. | .825 / | .97 |
| Purple | lb. | 3.36 / | 3.46 |
| Reds | lb. | 1.605 / | 1.705 |
| White | lb. | .73 / | .83 |
| Yellow | lb. | .795 / | .895 |
| **R-C blacks** | lb. | 5.50 / | 21.30 |
| Browns | lb. | 4.375 / | 15.75 |
| Reds | lb. | .28 / | 15.05 |
| Yellows | lb. | 3.60 / | 14.05 |
| **Reichhold inorganic pigments:** | | | |
| Blues, iron | lb. | .53 | |
| Milori, pre-wet | lb. | .3625 | |
| Greens, chrome | lb. | .42 / | .44 |
| Reduced 25% | lb. | .19 | |
| Oranges, chrome | lb. | .35 | |
| Molybdate | lb. | .48 | |
| Yellows, chrome | lb. | .35 | |
| Zinc | lb. | .29 / | .34 |
| **Rez-N-Dye (dry wt.)** | lb. | 7.50 | |
| **Rona Natural Pearl Essence:** | | | |
| Radiant | lb. | 16.00 | |
| Supreme | lb. | 19.00 | |
| **Synthetic Pearlescent Pigments:** | | | |
| 100 | lb. | 2.25 / | 2.50 |
| 200, 300 | lb. | 1.30 / | 1.45 |
| 1000 | lb. | 2.05 / | 2.15 |
| 1025 | lb. | 3.60 / | 4.00 |
| 2100 | lb. | 3.30 / | 3.45 |
| KV | lb. | 6.50 | |
| NLV | lb. | 3.40 / | 3.50 |
| RAL | lb. | 2.15 / | 2.45 |
| S5 | lb. | 6.50 | |
| **Saran colors** | lb. | .59 / | 1.80 |
| **Sherwin-Williams Dispersed** | | | |
| Colors | lb. | .55 / | 1.97 |
| Inorganic colors, oranges, yellows | lb. | .32 / | .45 |
| Organic colors, blues | lb. | .90 / | 3.60 |
| Greens | lb. | 1.35 / | 3.95 |
| Reds | lb. | .85 / | 4.40 |
| Yellows | lb. | .55 / | 1.97 |
| **Vansul Organic Drys** | | | |
| Blues | lb. | 3.45 / | 3.60 |
| Greens | lb. | 1.35 / | 3.95 |
| Oranges | lb. | 2.21 / | 3.00 |
| Reds | lb. | .90 / | 4.40 |
| Yellows | lb. | 2.00 / | 2.25 |
| **VAP Dry Dispersions** | | | |
| Black | lb. | 1.00 | |
| Blues | lb. | 2.90 / | 3.60 |
| Greens | lb. | 3.20 / | 4.05 |
| Oranges | lb. | 1.45 / | 2.55 |
| Reds | lb. | 1.70 / | 4.45 |
| Yellows | lb. | 1.35 / | 2.55 |
| **VP-Series Pastes** | | | |
| Black | lb. | .70 | |
| Blue | lb. | 1.65 | |
| Brown | lb. | 1.55 | |
| Green | lb. | 2.05 | |
| Oranges | lb. | .80 / | 2.30 |
| Reds | lb. | 1.15 / | 2.55 |
| White | lb. | .47 / | .65 |
| Yellows | lb. | .60 / | 1.65 |
| **VPE-Series Pastes** | | | |
| Black | lb. | .90 | |
| Blue | lb. | 1.85 | |
| Green | lb. | 2.10 | |
| Orange | lb. | 1.00 | |
| Reds | lb. | 1.45 / | 2.30 |
| White | lb. | .90 | |
| Yellows | lb. | 1.60 / | 2.00 |
| **VY Chips** | | | |
| Blacks | lb. | .90 / | 1.30 |
| Blues | lb. | 1.00 / | 2.25 |
| Brown | lb. | 1.60 | |
| Greens | lb. | $0.90 / | $02.45 |
| Oranges | lb. | 1.00 / | 2.15 |
| Reds | lb. | 1.40 / | 2.70 |
| White | lb. | .65 | |
| Yellows | lb. | .85 / | 1.80 |
| **Vinylized colors, blacks,** | | | |
| whites | lb. | .755 | |
| Blues | lb. | 1.16 / | 1.18 |
| Golds | lb. | 1.51 | 1.57 |
| Green | lb. | 1.45 | |
| Metallic | lb. | 1.15 | |
| Orange | lb. | .83 | |
| Reds | lb. | 1.15 | 2.27 |
| Yellows | lb. | .76 | 1.09 |
| **Violite 199, green** | lb. | 2.95 | |
| 200, yellow | lb. | 3.75 | |
| PL 3-60, blue | lb. | 3.25 | |
| 18-70, blue | lb. | 3.70 | |
| **Williams colors & pigments:** | | | |
| Blacks, iron oxide | lb. | .1425, | .145 |
| Browns, iron oxide | lb. | .1525/ | .155 |
| Burnt umbers | lb. | .0775/ | .095 |
| Greens, chromium oxide | lb. | .42 / | .4875 |
| Reds, 100 series, 1,000 | | | |
| series, RY series | lb. | .1375/ | .14 |
| Kromas | lb. | .1375/ | .15 |
| Yellows, iron oxide | lb. | .115 / | .1225 |
| **Witcoblack 12** | lb. | .0725/ | .14 |
| 32 | lb. | .1225/ | .20 |
| 50 | lb. | .0975/ | .175 |
| 100 | lb. | .26 / | .34 |
| Pellets | lb. | .26 / | .34 |
| F-1 | lb. | .0575/ | .12 |
| Hitone | lb. | .36 / | .44 |
| Pellets | lb. | .36 / | .44 |
| **Zopaque, anatase** | lb. | .255 / | .265 |
| Rutile | lb. | .265 / | .285 |

## Dispersing Agents

| | | | |
|---|---|---|---|
| **Darvan 1, 2, 3** | lb. | .22 / | .30 |
| 7 | lb. | .1875/ | .2375 |
| **Dewey & Almy Daxads:** | | | |
| 11, 15, 23, 27 | lb. | .201 / | .30 |
| 11KLS | lb. | .248 / | .35 |
| 11SPN | lb. | .1525/ | .1575 |
| 21 | lb. | .08 / | .20 |
| 30 | lb. | .185 / | .25 |
| **Isomul extra** | lb. | .30 | |
| **Tamol 731** | lb. | .185 / | .1875 |

## Fillers

| | | | |
|---|---|---|---|
| **Advaresin CXF** | lb. | .49 / | .55 |
| KF | lb. | .38 / | .44 |
| **A. F. D.** | ton | 26.50 / | 60.00 |
| **Albacar 5950, 5960, 5970** | ton | 50.00 / | 55.00 |
| **Aluminum Flake** | ton | 23.50 / | 30.00 |
| **Anhydrous calcium sulfate** | | | |
| W-1320 | ton | 47.00 / | 52.00 |
| **Atomite** | ton | 32.50 | |
| **Barytes, No. 1** | ton | 45.00 / | 65.75 |
| **Burgess Iceburg Pigment** | ton | 50.00 | |
| Pigment No. 30 | ton | 37.00 | |
| **Cab-o-sil** | lb. | .68 / | .75 |
| **Calcene NC** | lb. | .036 / | .059 |
| TM | lb. | .0375/ | .0625 |
| **Camel—CARB** | ton | 12.00 | |
| —TEX | ton | 20.00 | |
| —WITE | ton | 32.50 | |
| **Cotton flocks** | lb. | .12 / | .32 |
| **Crown Clay** | ton | 14.00 | |
| **Dixie Clay** | ton | 14.00 / | 34.50 |
| **Duramite** | ton | 20.00 | |
| **Emerson & Cuming Filler** | | | |
| BA | lb. | | 2.00 |
| **English Mica:** | | | |
| Waterground mica 160 | | | |
| mesh | lb. | .08 / | .0875 |
| 325 mesh | lb. | .0825/ | .09 |
| **Georgia Kaolin clays:** | | | |
| Hydri te | ton | 26.00 | |
| Flat | ton | 25.00 | |
| PD-10 | ton | 49.00 | |
| PD-121 | ton | 20.00 | |
| PX | ton | 41.00 | |
| **Harwick fillers:** | | | |
| Clays, Champion | ton | 14.00 / | 36.00 |
| Harwick | ton | 20.50 / | 55.50 |
| Flock, white | lb. | .11 / | .28 |
| Colored | lb. | .11 / | .19 |
| Magnesium carbonate | lb. | .105 / | .13 |
| Magnesia, tech | lb. | .055 / | .345 |
| Mica, Silversheen | lb. | .08 / | 0875 |
| Pecan shell flour | ton | 45.00 / | 106.00 |
| Stan white 325 | ton | 11.50 / | 23.50 |
| Walnut shell flours: | | | |
| 100W, 200WD | ton | 50.00 / | 60.00 |
| 200W | ton | 60.00 / | 70.00 |
| 200WB | ton | 62.00 / | 72.00 |
| 325W | ton | 74.00 / | 84.00 |
| **Hi-Sil 101** | lb. | .10 / | .155 |
| 233 | lb. | .09 / | .105 |
| **Huber Clays:** | | | |
| Coating grade X-44 | ton | 21.00 / | 26.00 |
| Hydrasperse | ton | 21.50 / | 34.00 |
| **Hi-White R** | ton | 18.50 | |
| Paragon | ton | 14.50 / | 18.50 |
| Polyfil | ton | 20.00 | |
| Suprex | ton | 14.00 / | 19.00 |
| Water-washed SWW, | | | |
| CWF | ton | 12.00 / | 17.00 |
| **Kalite** | ton | 50.00 / | 65.00 |
| **Kaolloid** | ton | 10.50 | |
| **Laminar** | lb. | .015 | |
| **Maglite** | lb. | .2525/ | .26 |
| **Marinco** | lb. | .105 / | .13 |
| **McMamee Clay** | ton | 13.50 / | 33.00 |

| | | | |
|---|---|---|---|
| Minerals & Chemical Corp.: | | | |
| Edgar ASP 200 | ton | $43.00 | |
| ASP 400 | ton | 24.00 | |
| ASP 600 | ton | 25.00 | |
| ASP 900 | ton | 19.50 | |
| ASP 1300 | ton | 80.00 | |
| Multiflex MM | ton | 110.00 | /$125.00 |
| Nytal 200L | ton | 27.00 | / 50.00 |
| 300 | ton | 37.00 | / 60.00 |
| Omya BSH | ton | 45.00 | |
| Plymouth Cordage Sisal Fibers | lb. | .1825 | / .20 |
| Secco Clay | ton | 12.00 | |
| Silene EF | lb. | .06 | / .07 |
| Sno-Brite Clay | ton | 12.50 | |
| Snowflake | ton | 20.00 | |
| Sparmite | ton | 80.00 | / 105.00 |
| Surtex MM | ton | 37.00 | / 52.00 |
| Suspenso | ton | 33.00 | / 48.00 |
| Tamms Satin Talc | ton | 22.50 | / 46.00 |
| Velveteen R Silica | ton | 23.00 | / 28.00 |
| U.S. Mica, dry grind | lb. | .04 | / .065 |
| Witcarb P | ton | 110.00 | / 140.00 |
| R | ton | 120.00 | / 150.00 |
| Regular | ton | 56.75 | / 85.00 |
| Wollastonite F-1 | ton | 23.00 | / 25.00 |
| P-1 | ton | 25.00 | / 27.00 |

## Finishes

| | | | |
|---|---|---|---|
| Logoquant colors | gal. | 3.25 | / 6.30 |
| Toy gloss, acetate | gal. | 2.35 | / 4.30 |
| Metal | gal. | 2.45 | / 4.10 |
| Polystyrene | gal. | 2.45 | / 4.70 |

## Flame-Proofing Agents

| | | | |
|---|---|---|---|
| IC-776 Antimony Concentrate | lb. | .495 | / .51 |
| M&T Antimony oxide | lb. | .245 | / .26 |

## Glass Reinforcements

| | | | |
|---|---|---|---|
| Chrome 60-end Roving: | | | |
| FBF-7.1, -7.3 | lb. | .40 | / .44 |
| FBF-7.5, -7.7 | lb. | .42 | / .46 |
| Garan 60-end Roving: | | | |
| FBF-7.2, -7.4 | lb. | .42 | / .46 |
| FBF-7.6, -7.8 | lb. | .44 | / .48 |
| Vitron 60-end Roving: | | | |
| VR-12 | lb. | .48 | / .52 |

## Lubricants

| | | | |
|---|---|---|---|
| Advawax 280 | lb. | .365 | / .39 |
| Baselube | qt. | 2.50 | / 4.00 |
| Dow Corning 7 Compound | lb. | 5.30 | / 6.50 |
| 20 Compound | lb. | 1.74 | / 4.95 |
| 20 Emulsion | lb. | .90 | / 3.50 |
| 36 Emulsion | lb. | 1.22 | / 1.40 |
| Mold Release Fluid | lb. | 3.20 | / 4.75 |
| Emerson & Cuming Mold Release 522 | lb. | 9.00 | / 11.00 |
| Garalease 915 | gal. | 3.80 | / 4.50 |
| GE silicone-emulsions | lb. | 1.20 | / 1.76 |
| IC-500 | gal. | 2.50 | |
| -571 | gal. | 3.25 | |
| -793-10 | gal. | 3.40 | |
| IMS sprays, silicone, neutral oil | can | 1.37 | / 2.00 |
| Zinc stereate, dry powder | lb. | 1.00 | / 2.00 |
| Isochem wax 270 | lb. | .295 | |
| Lubrex | lb. | .27 | / .32 |
| Lunn-Lease | gal. | 3.80 | / 4.25 |
| M-1 Mold Release | lb. | 3.00 | / 4.00 |
| Metasap barium stearate | lb. | .41 | / .46 |
| Calcium 627 | lb. | .40 | / .45 |
| Stearate | lb. | .41 | / .46 |
| Magnesium stearate | lb. | .42 | / .47 |
| ML-4 Separating Film | lb. | .30 | / .40 |
| Mold-Ease Concentrate PCR | qt. | 2.50 | / 5.85 |
| Mold Release 225 | gal. | 5.55 | / 6.00 |
| 235 | gal. | 6.00 | |
| Mold-Wiz | gal. | 4.00 | / 6.00 |
| Part-A-Part | gal. | 3.05 | / 3.75 |
| Partingkote 823 | qt. | 1.18 | / 2.18 |
| Prepoxy | gal. | 7.20 | / 12.80 |
| Plaskon 8406, 8407 | lb. | .30 | / .37 |
| 8416, 8417 | lb. | .35 | / .42 |
| 8429 | lb. | .40 | / 47 |
| Poly-Lease 77 | 16 oz. | 1.40 | / 1.50 |
| Real-Ease | 20 oz. | 1.10 | / 1.60 |
| Releasor Wax No. 826 | lb. | 2.29 | |
| Slide | 20 oz. | 1.25 | / 2.00 |
| Sprits | 20 oz. | 1.00 | / 1.25 |
| SS-452 | gal. | 2.80 | / 4.90 |
| Super King Bomb-Lube | 20 oz. | 1.75 | / 2.50 |
| Toplube | qt. | 2.50 | / 4.00 |
| Vibrin-VPA Parting Agent | gal. | 4.25 | / 4.65 |

## Mica

| | | | |
|---|---|---|---|
| Dry Ground Mica | lb. | .04 | / .065 |
| Mycalex 385 & 400, rods, 18 in. length | | .90 | / 3.35 |
| Sheets, 14 x 18 inches | | 5.70 | / 22.40 |
| K, rods, 18-in. length | | 1.80 | / 6.70 |
| Sheets, 14 x 18 inches | | 11.40 | / 44.80 |
| Supramica 500, rods, 18-in. length | | 1.08 | / 4.02 |
| Sheets, 14 x 18 inches | | 6.84 | / 26.88 |
| Waterground Mica | lb. | .08 | / .09 |

## Miscellaneous

| | | | |
|---|---|---|---|
| Dutch Boy Bentone | lb. | $0.44 | / $0.60 |
| Ben-A-Gel | lb. | .98 | / 1.40 |
| IMS Two-Step Mold Surface Saver | Can | 1.50 | / 2.00 |
| Isochem Defoamer 711 | lb. | .195 | |
| Metasap Water Proofing Agent 569 | lb. | .21 | |
| PMS Purging Compound | lb. | .35 | |
| Ultra violet absorber #9 | lb. | 5.25 | / 5.75 |

## Plasticizers

| | | | |
|---|---|---|---|
| Adipol 2EH, 10A, XX | lb. | .40 | / .435 |
| BCA | lb. | .43 | / .455 |
| ODY | lb. | .43 | / .465 |
| Admex | lb. | .3325 | / .3625 |
| 711 | lb. | .3525 | / .3825 |
| 744, 745 | lb. | .3925 | / .4225 |
| 760 | lb. | .5725 | / .6025 |
| 761 | lb. | .4425 | / .4725 |
| 562 | lb. | .4825 | / .5125 |
| Akron MP | lb. | .305 | |
| Araldite No. 1 | lb. | .765 | / 1.55 |
| Arnold-Hoffman butyl oleate | lb. | .20 | / .30 |
| Butyl stearate | lb. | .2275 | / .2675 |
| Barrett dibutyl phthalate | lb. | .30 | / .335 |
| Dimethyl phthalate | lb. | .28 | / .315 |
| Plasticizer 136 | lb. | .175 | / .21 |
| Benzoflex 2-45 | lb. | .26 | / .29 |
| 9-88 | lb. | .32 | / .35 |
| Cabflex DDA, DI-OA, DOA, ODA | lb. | .425 | / .455 |
| DDP, DI-OP, DOP, ODP | lb. | .305 | / .335 |
| Di-BA | lb. | .4325 | / .4625 |
| Di-OZ | lb. | .48 | / .51 |
| HS-10 | lb. | .44 | / .47 |
| TCP | lb. | .345 | / .375 |
| Celanese Celluflex 21 | lb. | .35 | / .375 |
| 23 | lb. | .3925 | / .4175 |
| 112, 179A, 179C, 179EG, Lindol | lb. | .325 | / .36 |
| DBP | lb. | .30 | / .335 |
| DOP | lb. | .28 | / .315 |
| Triphenyl phosphate | lb. | .415 | / .435 |
| Chlorowax 40 | lb. | .1525 | / .1825 |
| 50 | lb. | .1675 | / .1875 |
| 70 | lb. | .185 | / .25 |
| 70-S | lb. | .21 | / .275 |
| LV | lb. | .1725 | / .2025 |
| Columbian Carbon butyl stearate | lb. | .2525 | / .3425 |
| Capryl alcohol | lb. | .195 | / .30 |
| Caprylene | lb. | .10 | / .205 |
| Dibenzyl sebacate | lb. | .92 | / 1.01 |
| Dibutyl phthalate | lb. | .30 | / .395 |
| Dibutyl sebacate, CP | lb. | .68 | / .77 |
| Dicapryl phthalate | lb. | .27 | / .36 |
| Dihexyl adipate | lb. | .40 | / .495 |
| Dihexyl phthalate | lb. | .30 | / .395 |
| Dihexyl sebacate | lb. | .65 | / .74 |
| Diisodecyl phthalate | lb. | .29 | / .385 |
| Diisooctyl adipate | lb. | .40 | / .495 |
| Diisooctyl phthalate | lb. | .28 | / .375 |
| Diocytl adipate | lb. | .40 | / .495 |
| Dioctyl phthalate | lb. | .28 | / .375 |
| Dimethyl sebacate | lb. | 1.30 | / 1.39 |
| Dioctyl sebacate | lb. | .60 | / .69 |
| Harchemex | lb. | .24 | / .345 |
| Harflex 300 | lb. | .58 | / .675 |
| 325 | lb. | .4325 | / .52 |
| 500 | lb. | .315 | / .41 |
| Isooctyldecyl phthalate | lb. | .285 | / .38 |
| Methyl ethyl ketone | lb. | .26 | / .365 |
| Sebacic acid, CP | lb. | .77 | / .89 |
| Purified | lb. | .69 | / .81 |
| Conoco H-300 | lb. | .06 | / .10 |
| Darex DIBA | lb. | .4325 | / .4675 |
| DIBM | lb. | .305 | / .34 |
| DIBP | lb. | .30 | / .335 |
| DIDA, DIOA | lb. | .40 | / .435 |
| DIDP | lb. | .29 | / .325 |
| DIOP, DOP | lb. | .285 | / .32 |
| DOS | lb. | .60 | / .63 |
| Dinopol 235 | lb. | .335 | / .37 |
| IDO | lb. | .285 | / .32 |
| MOP | lb. | .29 | / .325 |
| Dow Plasticizer No. 5 | lb. | .315 | / .54 |
| Resin 276-V2,-V9 | lb. | .265 | / .325 |
| Drapex 3.2 | lb. | .40 | / .49 |
| Drew DP-100, DP-200 | lb. | .4175 | / .46 |
| DP-250 | lb. | .4275 | / .47 |
| DP-316 | lb. | .2925 | / .335 |
| DP-317 | lb. | .555 | / .5975 |
| DP-520 | lb. | .415 | / .4575 |
| SC | lb. | .435 | |
| Dutch Boy Plasticizer NL-A10 (DBP) | lb. | .30 | .33 |
| NL-A20 (DOP), NL-A30 (DIOP) | lb. | .305 | / .335 |
| NL-C20 (DOS) | lb. | .61 | / .63 |
| NL-F21 | lb. | .395 | / .425 |
| NL-F31 | lb. | .44 | / .47 |
| NL-F41 | lb. | .48 | / .51 |
| NL-A54 | lb. | .295 | / .325 |
| Eastman di(2 ethyl hexyl) adipate, P.E. | lb. | .40 | / .435 |
| DI (2 ethyl hexyl) azelate | lb. | .455 | / .49 |
| Di-(2 ethyl hexyl) phthalate | lb. | .28 | / .315 |
| DI-(2ethylhexyl) sebacate | lb. | .61 | / .645 |
| Di(methoxy ethyl) phthalate | lb. | .425 | / .46 |
| Diisobutyl adipate | lb. | $0.41 | / $0.445 |
| Dibutyl phthalate | lb. | .30 | / .335 |
| Diethyl phthalate | lb. | .275 | / .31 |
| Diisobutyl phthalate | lb. | .29 | / .325 |
| Dimethyl phthalate | lb. | .295 | / .33 |
| Dinonyl phthalate | lb. | .28 | / .315 |
| Plasticizer 84 | lb. | .27 | / .305 |
| Polymeric plasticizer NP-10 | lb. | .50 | / .53 |
| Triacetin | lb. | .365 | / .40 |
| Tributyrin | lb. | .69 | |
| Elastex 10-P, 28-P | lb. | .28 | / .315 |
| 18-P | lb. | .285 | / .32 |
| 20-A, 60-A | lb. | .40 | / .435 |
| 40-P, 48-P | lb. | .27 | / .305 |
| 50-B | lb. | .265 | / .30 |
| 80-P | lb. | .275 | / .31 |
| 90-P | lb. | .29 | / .325 |
| DCHP, cast solid | lb. | .58 | / .59 |
| Granular | lb. | .595 | / .605 |
| Ethox | lb. | .50 | / .525 |
| Flexol 3GH | lb. | .44 | / .46 |
| 3G0 | lb. | .53 | / .55 |
| 4G0 | lb. | .325 | / .35 |
| 8N8 | lb. | .355 | / .38 |
| 10-10, 10-A | lb. | .29 | / .315 |
| 77-G, 426 | lb. | .27 | / .295 |
| 380 | lb. | .305 | / .33 |
| 810 | lb. | .285 | / .31 |
| A-26 | lb. | .40 | / .425 |
| B-400 | lb. | .25 | / .275 |
| CC-55 | lb. | .305 | / .33 |
| DOP | lb. | .28 | / .305 |
| R2H | lb. | .59 | |
| TOF | lb. | .43 | / .455 |
| Flexricin 66 | lb. | .3275 | |
| P-4 | | .30 | |
| P-6 | lb. | .37 | |
| P-8 | lb. | .32 | |
| Good-Rite GP-233, -235, -236 | lb. | .40 | / .435 |
| GP-261 | lb. | .285 | / .32 |
| GP-265 | lb. | .29 | / .325 |
| GP-266 | lb. | .295 | / .33 |
| Harchem butyl stearate | lb. | .2525 | / .3425 |
| Capryl alcohol | lb. | .195 | / .30 |
| Caprylene | lb. | .10 | / .205 |
| Dibenzyl sebacate | lb. | .92 | / 1.01 |
| Dibutyl phthalate | lb. | .30 | / .395 |
| Dibutyl sebacate | lb. | .68 | / .77 |
| Dicapryl phthalate | lb. | .27 | / .36 |
| Dihexyl adipate | lb. | .40 | / .495 |
| Dihexyl phthalate | lb. | .30 | / .395 |
| Dihexyl sebacate | lb. | .65 | / .74 |
| Diisodecyl phthalate | lb. | .29 | / .385 |
| Diisooctyl adipate | lb. | .40 | / .495 |
| Diisooctyl phthalate | lb. | .28 | / .375 |
| Dimethyl sebacate | lb. | 1.30 | / 1.39 |
| Dioctyl adipate | lb. | .40 | / .495 |
| Dioctyl phthalate | lb. | .28 | / .375 |
| Dioctyl sebacate | lb. | .60 | / .69 |
| Harchemex | lb. | .24 | / .345 |
| Harflex 300 | lb. | .58 | / .675 |
| 325 | lb. | .4325 | / .52 |
| 500 | lb. | .315 | / .41 |
| Isooctyldecyl phthalate | lb. | .285 | / .38 |
| Methyl hexyl ketone | lb. | .26 | / .365 |
| Sebacic acid, CP | lb. | .77 | / .89 |
| Purified | lb. | .69 | / .81 |
| Harshaw dibutyl phthalate | lb. | .325 | / .385 |
| Kapsol | lb. | .33 | / .355 |
| Kessoflex BCL | lb. | .365 | / .375 |
| BCO | lb. | .355 | / .365 |
| BCP | lb. | .33 | / .36 |
| BCS | lb. | .305 | / .315 |
| BO | lb. | .26 | / .28 |
| BS | lb. | .235 | / .26 |
| DBT | lb. | .64 | |
| DDA, DIOA, DOA | lb. | .40 | / .435 |
| DOZ | lb. | .46 | / .50 |
| MCO | lb. | .3225 | / .3525 |
| MCP | lb. | .37 | / .40 |
| MCS | lb. | .33 | / .34 |
| ODA | lb. | .47 | / .50 |
| TRA | lb. | .37 | / .40 |
| KP-23 | lb. | .315 | / .32 |
| -90 | lb. | .40 | / .435 |
| -140 | lb. | .46 | / .485 |
| -201 | lb. | .58 | / .59 |
| -220, 260 | lb. | .33 | / .365 |
| -555 | lb. | .595 | / .60 |
| Kronisol | lb. | .33 | / .365 |
| Kronitex AA, I, K-3, MX | lb. | .325 | / .36 |
| Methox | lb. | .385 | / .41 |
| Monoplex DBS | lb. | .64 | / .665 |
| DCP | lb. | .2925 | / .32 |
| DOS | lb. | .58 | / .605 |
| S-38 | lb. | .215 | / .24 |
| S-70 | lb. | .3925 | / .42 |
| S-71 | lb. | .45 | / .475 |
| Monsanto dibutyl phthalate | lb. | .30 | / .33 |
| Diethyl phthalate | lb. | .25 | / .28 |
| Dimethyl phthalate | lb. | .275 | / .305 |
| Diphenyl phthalate | lb. | .5175 | / .5375 |
| DIDA, DOA | lb. | .425 | / .455 |
| DIDP, DIOP, DOP | lb. | .305 | / .335 |
| HB-20 | lb. | .15 | / .17 |
| HB-40 | lb. | .22 | / .24 |
| Orthonitrobiphenyl | lb. | .13 | / .15 |
| Tricresyl phosphate | lb. | .325 | / .36 |
| Triphenyl phosphate | lb. | .39 | / .40 |
| Morflex P-50 | lb. | .68 | / .71 |
| Naugatuck decylbutyl phthalate | lb. | .27 | / .30 |
| Dibutyl phthalate | lb. | .30 | / .33 |
| Sebacate | lb. | .645 | / .67 |
| Diisooctyl adipate, dioctyl adipate | lb. | .425 | / .455 |

| | | | |
|---|---|---|---|
| Diisooctyl phthalate, dioctyl phthalate, Isooctyl decyl phthalate | lb. | $0.305 / | $0.335 |
| Dinonyl adipate | lb. | .445 / | .475 |
| Dioctyl sebacate | lb. | .585 / | .61 |
| Epoxy plasticizer | lb. | .335 / | .36 |
| Tricresyl phosphate | lb. | .345 / | .375 |
| Ohio-Apex butyl oleate | lb. | .255 / | .265 |
| Stearate | lb. | .22 / | .255 |
| Diallyl phthalate | lb. | .49 / | .525 |
| Dibutyl phthalate | lb. | .30 / | .335 |
| Di-Carbitol phthalate | lb. | .49 / | .495 |
| Diisobutyl adipate | lb. | .41 / | .445 |
| Diisodecyl phthalate | lb. | .29 / | .325 |
| Dioctyl phthalate | lb. | .28 / | .315 |
| D.I.O.P. | lb. | .28 / | .315 |
| Tributyl phosphate | lb. | .50 / | .535 |
| Ohopex Q-10 | lb. | .28 / | .315 |
| R-9 | lb. | .3525/ | .3775 |
| Paraplex S-B | lb. | .29 / | .3475 |
| AL-111 | lb. | .32 / | .3275 |
| G-20 | lb. | .76 / | .7675 |
| G-25 | lb. | .76 / | .77 |
| G-40 | lb. | .4825/ | .51 |
| G-50 | lb. | .39 / | .4175 |
| G-53 | lb. | .4325/ | .46 |
| G-60, -61 | lb. | .3325/ | .36 |
| G-62 | lb. | .3525/ | .38 |
| RG-2 | lb. | .41 / | .6575 |
| RG-7 | lb. | .33 / | .6575 |
| RG-8 | lb. | .505 / | .335 |
| RG-10 | lb. | .52 / | .5125 |
| Pfizer acetyl tributyl citrate, tech | lb. | .32 / | .5275 |
| Acetyl triethyl citrate, tech. | lb. | .36 / | .57 |
| Triethyl citrate | lb. | .4575/ | .58 |
| Plasticizer 1 | lb. | 1.17 / | 1.37 |
| Plasticizer 120 | lb. | .44 / | .49 |
| Plastoflex #3 | lb. | .52 / | .57 |
| #520 | lb. | .36 / | .435 |
| DBE | lb. | .50 / | .55 |
| MGB | lb. | .29 / | .37 |
| VS | lb. | .3575/ | .3975 |
| Plastolein 9050 DHZ | lb. | .52 / | .56 |
| 9055 DGP | lb. | .28 / | .32 |
| 9057 DIOZ | lb. | .455 / | .50 |
| 9058 DOZ | lb. | .455 / | .50 |
| 9078LT | lb. | .40 / | .445 |
| 9250 THFO | lb. | .3575/ | .4025 |
| 9404 TGP | lb. | .3725/ | .4175 |
| 9715 & 9720 Polymeric | lb. | .365 / | .43 ç |
| Polyciser 162, 562, 662 | lb. | .285 / | .41 |
| 332, 532, 632 | lb. | .40 / | .555 |
| Polycon #7, 9, 10, 11 | lb. | .305 / | .335 |
| #30 | lb. | .30 / | .33 |
| #31 | lb. | .27 / | .30 |
| #40 | lb. | .245 / | .275 |
| PX-104 | lb. | .30 / | .33 |
| -108, -118, -120, -138 | lb. | .305 / | .335 |
| -114 | lb. | .27 / | .30 |
| -208, -220, -238 | lb. | .425 / | .455 |
| -404 | lb. | .645 / | .67 |
| -438 | lb. | .585 / | .61 |
| -800 | lb. | .325 / | .35 |
| -917 | lb. | .33 / | .36 |
| Pycal 40 | lb. | .3875/ | .4375 |
| 60 | lb. | .60 / | .635 |
| 62 | lb. | .80 / | .835 |
| 94 | lb. | .3275/ | .3775 |
| 140 | lb. | .35 / | .40 |
| 170 | lb. | .275 / | .325 |
| 194 | lb. | .2775/ | .3275 |
| RC Plasticizers: | | | |
| B-17 | lb. | .21 / | .245 |
| BD-8 | lb. | .38 / | .4125 |
| BIDP | lb. | .27 / | .305 |
| DIDA, DIOA, DOA, ODA | lb. | .40 / | .435 |
| DIDP | lb. | .29 / | .325 |
| DIOP, DOP | lb. | .28 / | .315 |
| DIOS, DOS | lb. | .60 / | .63 |
| O-16 | lb. | .275 / | .3075 |
| ODP | lb. | .285 / | .32 |
| TG-8 | lb. | .3125/ | .3425 |
| TG-9 | lb. | .41 / | .4425 |
| Santicizer 1-H | lb. | .50 / | .51 |
| 3 | lb. | .46 / | .47 |
| 8 | lb. | .43 / | .44 |
| 9 | lb. | .39 / | .42 |
| 140 | lb. | .325 / | .36 |
| 141 | lb. | .34 / | .37 |
| 160 | lb. | .25 / | .28 |
| 213 | lb. | .27 | |
| 214 | lb. | .29 | |
| 601 | lb. | .32 | |
| 602 | lb. | .305 | |
| B-16 | lb. | .4875/ | .4975 |
| E-15 | lb. | .5075/ | .5375 |
| M-17 | lb. | .4275/ | .4575 |
| Staflex AX | lb. | .43 | |
| BR | lb. | .26 / | .29 |
| CP | lb. | .28 / | .31 |
| DBES, DOS | lb. | .61 / | .635 |
| DIOA, ODA | lb. | .435 / | .465 |
| DIOP, DOP, MP | lb. | .305 / | .335 |
| DOZ | lb. | .48 / | .5075 |
| IXA | lb. | .32 / | .35 |
| KA | lb. | .36 / | .3875 |
| KD | lb. | .44 / | .4675 |
| Witciser #100 | lb. | .26 / | .27 |
| #101 | lb. | .31 / | .32 |
| #200 | lb. | .195 / | .205 |
| #201 | lb. | .235 / | .245 |
| #300 | lb. | .30 / | .33 |
| #312, 313 | lb. | .305 / | .33 |
| #412 | lb. | .435 / | .465 |

## Resins & Molding Compounds

### Acrylic

| | | | |
|---|---|---|---|
| Cadco cast rods | lb. | $1.63 / | $6.47 |
| polished | lb. | 1.89 / | 7.22 |
| tubes | lb. | 1.39 / | 5.12 |
| Lucite injection molding powders: | | | |
| Colorless, transparent | lb. | .55 | |
| Std. colors | lb. | .59 / | 1.00 |
| Stock colors | lb. | .59 / | .84 |
| Granular Powders for compression & extrusion | lb. | .51 / | .75 |
| Plexiglas molding powders: | | | |
| Colorless | lb. | .55 / | .80 |
| Colors, stock | lb. | .59 / | .84 |
| Custom | lb. | .59 / | 1.00 |
| Sheets, Types I-A & II | | | |
| Colorless | sq. ft. | .80 / | 22.18 |
| Colors | sq. ft. | .88 / | 1.10 |
| Type R, Colorless | sq. ft. | .60 / | 12.64 |
| Colors | sq. ft. | .69 / | 1.07 |
| Type RL, colorless | sq. ft. | 1.27 / | 1.50 |
| Colors | sq. ft. | 1.52 / | 1.80 |
| Polycast 1 | sq. ft. | .80 / | 2.40 |

### Alkyd

| | | | |
|---|---|---|---|
| Plaskon foundry resin 580-11L | lb. | .245 / | .275 |
| Molding Compound, | | | |
| Type 411 | lb. | .43 / | .60 |
| Type 413, 417 | lb. | .57 / | .74 |
| Type 420 black | lb. | .44 / | .695 |
| Type 422 colored | lb. | .51 / | .695 |
| Mottle | lb. | .52 / | .705 |
| Natural | lb. | .49 / | .60 |
| Type 430 | lb. | .34 / | .50 |

### Cellulosic

| | | | |
|---|---|---|---|
| Cellulose acetate: | | | |
| Celanese cast & extruded film: | | | |
| Standard length rolls, clear | lb. | .67 / | 1.03 |
| Colors | lb. | .93 / | 1.19 |
| Matte finish | lb. | 1.48 / | 1.82 |
| Stock & cut sheets, clear | M. sq. in. | .033 / | .11 |
| Colors | M. sq. in. | .044 / | .136 |
| Matte finish | M. sq. in. | .089 / | .165 |
| Celanese cast sheeting: | | | |
| Standard length rolls, clear | M. sq. in. | .129 / | 1.47 |
| Matte finish | M. sq. in. | .16 / | .657 |
| Tinted | M. sq. in. | .243 / | .722 |
| Stock & cut sheets, clear | M. sq. in. | .145 / | 1.55 |
| Matte finish | M. sq. in. | .183 / | .767 |
| Tinted | M. sq. in. | .259 / | .862 |
| Lumarith molding compounds: | | | |
| Group I | lb. | .52 / | .61 |
| Group II | lb. | .48 / | .57 |
| Group III | lb. | .41 / | .50 |
| Non-stock extruded rolls, clear | M. sq. in. | .14 / | 1.34 |
| Colors | M. sq. in. | .18 / | 1.65 |
| Extruded sheets, clear | M. sq. in. | .17 / | 2.34 |
| Colors | M. sq. in. | .19 / | 2.15 |
| Stock extruded rolls, clear | M. sq. in. | .14 / | .97 |
| Colors | M. sq. in. | .18 / | 1.00 |
| Extruded sheets, clear | M. sq. in. | .17 / | 1.84 |
| Colors | M. sq. in. | .19 / | 1.84 |
| Poly-Cell Group I | lb. | .50 / | .59 |
| Group II | lb. | .46 / | .55 |
| Group III | lb. | .38 / | .48 |
| Group IV | lb. | .57 / | .66 |
| Group V | lb. | .52 / | .61 |
| Tenite Acetate, Group 1 | lb. | .50 / | .59 |
| Group 2 | lb. | .46 / | .55 |
| Group 3 | lb. | .41 / | .51 |
| Group 4 | lb. | .38 / | .49 |
| Group 5 | lb. | .65 / | .75 |
| Cellulose acetate butyrate: | | | |
| Tenite butyrate | lb. | .62 / | .71 |
| A pearls | lb. | .72 / | .81 |
| Blacks, reprocessed | lb. | .50 / | .58 |
| Cellulose propionate: | | | |
| Forticel | lb. | .63 / | .71 |
| Essence pearls | lb. | .73 / | .81 |
| Reprocessed blacks | lb. | .41 / | .48 |
| Ethyl cellulose: | | | |
| Dyeform 720, 721 | lb. | 1.29 / | 1.52 |
| Ethocel PG | lb. | .72 / | .80 |
| Bulk, reg. | lb. | .66 / | .81 |
| Std., 7 cps. | lb. | .71 / | .86 |
| Hercocel E | lb. | .72 / | .88 |

### Epoxy

| | | | |
|---|---|---|---|
| Araldite 502, 506, 6003 | | | |
| 6010 | lb. | .77 / | .86 |
| 6020, 6030, 6040 | lb. | .80 / | .86 |
| 6060 | lb. | .75 / | .83 |
| 6071, 6075 | lb. | .615 / | .6225 |
| 6084 | lb. | .595 / | .6025 |
| 6097 | lb. | .6025/ | .6125 |
| 6099 | lb. | .69 / | .6975 |
| Bakelite ERL Series | lb. | $0.80 / | $0.995 |
| Emerson & Cuming: | | | |
| Eccobild 121 | lb. | 1.20 / | 1.60 |
| 127 | lb. | 3.50 / | 3.75 |
| 420 | lb. | .84 / | .99 |
| 430 | lb. | .90 / | 1.15 |
| 470 | lb. | 2.65 / | 3.25 |
| 490 | lb. | 1.50 / | 1.70 |
| Epi-Rez 504, 507 | | | |
| 510, 515 | lb. | .80 / | .86 |
| 520 | lb. | .615 / | .6225 |
| 522 | lb. | .605 / | .6125 |
| Epocast 2, 3, 5 | lb. | 1.33 / | 1.77 |
| 4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste | lb. | 1.09 / | 1.15 |
| Epon 562 | lb. | 1.52 / | 1.77 |
| 815 | lb. | .80 / | .99 |
| 820, 828 | lb. | .80 / | .97 |
| 834 | lb. | .855 / | 1.00 |
| 864 | lb. | .91 / | 1.06 |
| 864-C-75 | lb. | .73 / | .85 |
| 1001 | lb. | .615 / | .85 |
| 1004 | lb. | .595 / | .6025 |
| 1007 | lb. | .605 / | .6125 |
| 1009 | lb. | .69 / | .6975 |
| Furane CN-502 | lb. | 1.33 / | 1.77 |
| Jet-Kote (with cat.) | gal. | 7.50 / | 10.00 |
| Maraset 602, 610, 610V, 612B 613, 648 | lb. | 1.20 / | 1.70 |
| 604A, 607 | lb. | 1.1½ / | 1.40 |
| 608 | lb. | 1.17 / | 1.65 |
| 614A, 631A, 618A, 640 | lb. | 1.32 / | 1.77 |
| 645 | lb. | 1.15 / | 1.70 |
| Reichhold Polytool Resins: | | | |
| 6125, 6130, 6140 | lb. | .80 / | 1.58 |
| Rezolin L-900, 900W | lb. | 1.00 / | 1.94 |
| 902 | lb. | 2.41 | |
| 906 | lb. | 1.19 / | 1.80 |
| 910 | lb. | 1.086 / | 2.34 |
| 916, 916A | lb. | 1.19 / | 1.71 |
| 940 | lb. | 1.285 / | 2.29 |
| 930A | lb. | 1.29 / | 1.90 |
| 933A | lb. | 1.29 / | 1.80 |
| 953A | lb. | 1.665 / | 1.99 |
| LT-904 | lb. | .996 / | 1.83 |
| 914 | lb. | 1.073 / | 2.18 |
| 932 | lb. | 1.05 / | 1.79 |
| Sealcast 501 | lb. | 1.55 / | 1.65 |
| 502, 504, 505 | lb. | 1.75 / | 1.85 |
| 503 | lb. | 1.65 / | 1.75 |
| Sealfoam 601 | lb. | 2.90 / | 3.15 |
| 602 | lb. | 3.00 / | 3.25 |
| 603 | lb. | 2.50 / | 2.75 |
| 604 | lb. | 2.85 / | 3.10 |
| Toolplastik packages: | | | |
| L-900, L-930 | lb. | 1.59 / | 2.29 |
| L-902 | lb. | 1.69 / | 1.84 |
| L-904 | lb. | 1.54 / | 2.19 |
| L-910 | lb. | 1.94 / | 2.34 |
| L-914 | lb. | 1.83 / | 2.19 |
| L-931 | lb. | 1.75 / | 1.99 |
| L-940 | lb. | 2.05 / | 2.29 |

### Fluorocarbon

| | | | |
|---|---|---|---|
| Bakelite FGBB-33789, FGEB-34790, FXMA-50590, FXMB-50344 | lb. | 9.00 / | 10.00 |
| FGEB-32788, FXMB-50090 | lb. | 12.00 / | 14.00 |
| FYTD | lb. | 11.00 / | 13.00 |
| FYTH, FYTS | lb. | 8.50 / | 9.50 |
| Kel-F Grade 270, 300 | | | |
| High density | lb. | 6.50 / | 9.00 |
| Low density | lb. | 6.00 / | 8.50 |
| Grade 300—P-25 | | | |
| High density | lb. | 7.50 / | 10.00 |
| Low density | lb. | 7.00 / | 9.50 |
| Grade 500-F, 500-R | | | |
| High density | lb. | 7.00 / | 9.50 |
| Low density | lb. | 6.50 / | 9.00 |
| Polyfluoron, high density pellets, grades HT, MT, LT | lb. | 6.50 / | 9.00 |
| colored | lb. | 7.00 / | 9.50 |
| Low density pellets, Clear grades HT, MT, LT | lb. | 6.00 / | 8.50 |
| colored | lb. | 6.50 / | 9.00 |
| Mikron-atomized powder, clear dispersion grades HT, MT, LT | lb. | 8.00 / | 10.50 |
| colored | lb. | 8.50 / | 11.00 |
| Liquid dispersions, 40% HT, MT, LT | lb. | 4.20 / | 4.40 |
| 35% HT, MT, LT | lb. | 3.20 / | 3.85 |
| 30% HT, MT, LT | lb. | 3.15 / | 3.30 |
| 25% HT, MT, LT | lb. | 2.65 / | 2.75 |
| Teflon 1 | lb. | 4.50 / | 5.55 |
| 5 | lb. | 4.75 / | 5.80 |
| 6 | lb. | 7.45 / | 8.00 |
| 30 aqueous dispersion | lb. | 5.60 / | 6.85 |

### Melamines

| | | | |
|---|---|---|---|
| Fiberite 2015 (black & pastels) | lb. | .57 / | .62 |
| Pelleted | lb. | .61 / | .66 |
| Cymel 402 | lb. | .51 / | .53 |
| 404R, 404T | lb. | .85 / | .95 |
| 405 | lb. | .45 / | .52 |
| 428 | lb. | .48 / | .55 |
| 430 | lb. | .465 / | .535 |
| 440 | lb. | 1.10 | |
| 480 | lb. | .265 / | .315 |
| 1077, 1079 | lb. | .45 / | .75 |
| Ungranulated | lb. | .43 / | .73 |

| | | | |
|---|---|---|---|
| 1500 | lb. | $0.42 / | $0.55 |
| 1502 | lb. | .45 / | .58 |
| 3020 | lb. | .57 / | .72 |
| 3024-A | lb. | .67 | |
| 3135 | lb. | .85 / | 1.05 |
| 3136 | lb. | 1.05 / | 1.15 |
| P-592, -592-A | lb. | .65 / | .75 |
| Plaskon | lb. | .44 / | .75 |

**Phenolic**

| | | | |
|---|---|---|---|
| 91-LD | lb. | 1.50 / | 2 50 |
| Admirex PL-50 | lb. | .215 | |
| UP-11 | lb. | .2325 | |
| Bakelite general purpose | lb. | .187 / | .3525 |
| BMG-5000 | lb. | .19 / | .30 |
| Colors | lb. | .2375/ | .435 |
| Chem. resist. | lb. | .23 / | .40 |
| Electrical Insul. | lb. | .2725/ | .4125 |
| Heat resist. | lb. | .19 / | .35 |
| Impact resist. | lb. | .24 / | .40 |
| Barrett foundry resins, liquid | lb. | .2125/ | .2425 |
| Powdered | lb. | .27 / | .355 |
| Insulation resins | lb. | .15 / | .175 |
| Molding resin 313, 314, 317 | lb. | .27 / | .285 |
| 316 | lb. | .295 / | .31 |
| 1502, -3, -4, -5, R-110R | lb. | .25 / | .265 |
| R-114 | lb. | .285 / | .30 |
| Corfoam 107, 114 | lb. | .55 / | .82 |
| Cyacor 151 | lb. | .215 / | .235 |
| 191 | lb. | .13 / | .16 |
| Durez, Brake lining resins: | | | |
| 8054, powdered | lb. | .35 / | .39 |
| 13848, powdered | lb. | .29 / | .33 |
| 14000, powdered | lb. | .32 / | .36 |
| Foundry resins: | | | |
| 18115, liquid | lb. | .22 / | .23 |
| 18123, 18250, powdered | lb. | .265 / | .275 |
| Resins, rubber compounding: | | | |
| 12603, lump | lb. | .245 / | .255 |
| 12687, powdered | lb. | .36 / | .40 |
| 13355, powdered | lb. | .275 / | .315 |
| Resins, wood flour bonding: | | | |
| 12763, 18520, powdered | lb. | .30 / | .31 |
| Durite GP | lb. | .195 / | .24 |
| HR | lb. | .191 / | .3025 |
| IM | lb. | .24 / | .415 |
| SG | lb. | .195 / | .3575 |
| Dyform | lb. | 1.10 / | 1.35 |
| Fiberite 1078 | lb. | .43 / | .47 |
| 1153 | lb. | .47 / | .50 |
| 1164 | lb. | .475 / | .51 |
| 1270, 1330, 1332 | lb. | .395 / | .43 |
| 1271, 1347, 1389 | lb. | .40 / | .44 |
| 1346 | lb. | .42 / | .4925 |
| 2015 | lb. | .57 / | .63 |
| 4030 | lb. | .95 / | .99 |
| 4031 | lb. | .635 / | .65 |
| 4035 | lb. | .60 / | .82 |
| 6100 | lb. | 1.10 / | 1.12 |
| FM-926 | lb. | .44 / | .455 |
| -927 | lb. | .42 / | .435 |
| -1132, -3510, -3515 | lb. | .40 / | .43 |
| -1914, -1996 | lb. | .39 / | .405 |
| -10365, -11678 | lb. | .68 / | .715 |
| -11547, -17610 | lb. | 1.08 / | 1.10 |
| -14111 | lb. | .43 / | .445 |
| -17067 | lb. | .85 / | .865 |
| X409 | lb. | .285 / | .325 |
| G-E molding powders: | | | |
| 12401 | lb. | .31 / | .41 |
| 13408, 12486 | lb. | .205 / | .215 |
| 12410, 12420 | lb. | 1.50 / | 1.60 |
| 12432 | lb. | .405 / | .505 |
| 12433 | lb. | .565 / | .665 |
| 12435 | lb. | .25 / | .35 |
| 12439-A, 12466 | lb. | .265 / | .365 |
| 12444 | lb. | .435 / | .535 |
| 12463 | lb. | .415 / | .515 |
| 12467 | lb. | .51 / | .61 |
| 12487, 12489, 12884, 12887 | lb. | .365 / | .465 |
| 12491, 12493, 12853, 12900, 12901, 12902, 12920, 12921 | lb. | .21 / | .31 |
| 12494 | lb. | .385 / | .485 |
| 12808 | lb. | .50 / | .60 |
| 12809 | lb. | .66 / | .76 |
| 12871-A | lb. | .22 / | .32 |
| 12824 | lb. | .505 / | .605 |
| 12841, 12906 | lb. | .255 / | .355 |
| Loven LHR-401, -403 | lb. | .225 / | .23 |
| -407, -409 | lb. | .60 / | 1.00 |
| -408 | lb. | .25 / | .255 |
| LI-201 | lb. | .39 / | .40 |
| -207 | lb. | .475 / | .48 |
| -209 | lb. | .60 / | 1.00 |
| -212 | lb. | .425 / | .43 |
| LM-110, -119 | lb. | .19 / | .195 |
| -101 | lb. | .24 / | .245 |
| -116 | lb. | .255 / | .26 |
| -117 | lb. | .225 / | .23 |
| -118 | lb. | .1975/ | .2025 |
| LMI-301 | lb. | .2525/ | .2575 |
| -303 | lb. | .345 / | .35 |
| -304 | lb. | .60 / | 1.00 |
| -307 | lb. | .3075/ | .3125 |
| LMM-801, -803 | lb. | .2125/ | .2175 |
| -804, -811 | lb. | .245 / | .25 |
| 807 | lb. | .215 / | .22 |
| Marblette 76, 77 | lb. | .50 / | .60 |
| Foam resin 1076 | lb. | .50 / | .60 |
| Plenco foundry resins | lb. | .27 / | .35 |
| Molding cmpds. gen. purpose | lb. | .185 / | .235 |
| Heat resist. | lb. | .19 / | .24 |
| Improved impact | lb. | .225 / | .28 |
| Min. bleed | lb. | $0 185 / | $0.195 |
| Radio & TV | lb. | .20 / | .215 |
| Stock | lb. | .205 / | .34 |
| Reichhold Foundry Resins: | | | |
| Corciment | lb. | .135 / | .17 |
| Corovit | lb. | .275 / | .31 |
| Foundrez, core binder liquids | lb. | .21 / | .25 |
| Shell molding liquids | lb. | .195 / | .245 |
| Powders | lb. | .2675/ | .3025 |
| Plyophen molding cmpds.: | | | |
| 5440, 5596, 5655, 5660 | lb. | .30 / | .325 |
| 5510, 5510-C | lb. | .34 / | .365 |
| 5657, 5658, 5661 | lb. | .315 / | .34 |
| Reilly general purpose | lb. | .195 / | .20 |
| Heat & impact resist. | lb. | .20 / | .205 |
| Resinox molding compounds: | | | |
| Gen. purpose & heat resist | lb. | .205 / | .215 |
| Impact | lb. | .255 / | .3225 |
| Low elec. loss | lb. | .31 / | .365 |
| Special grade | lb. | .215 / | .255 |
| Rogers phenolic molding compounds: | | | |
| RX 425 | lb. | .29 / | .295 |
| Special colors | lb. | .34 / | .405 |
| RX 428 | lb. | .355 / | .36 |
| Special colors | lb. | .42 / | .465 |
| RX 429 | lb. | .365 / | .37 |
| Special colors | lb. | .395 / | .48 |
| RX 431 | lb. | .4125/ | .4175 |
| Special colors | lb. | .455 / | .55 |
| RX 438 | lb. | .4675/ | .4725 |
| RX 441, 455 | lb. | .32 / | .325 |
| RX 442 | lb. | .3475/ | .3525 |
| RX 447 | lb. | .5025/ | .51 |
| RX 448 | lb. | .355 / | .36 |
| RX 458 | lb. | .38 / | .385 |
| RX 469 | lb. | .365 / | .37 |
| RX 470, 480 | lb. | .40 / | .405 |
| RX 478, 488 | lb. | .415 / | .43 |
| RX 525, 545 | lb. | .29 / | .295 |
| RX 530 | lb. | .4125/ | .417 |
| Special colors | lb. | .42 / | 475 |
| RX 547 | lb. | .37 0 | 375 |
| RX 625 | lb. | .395 / | 40 |
| RX 628 | lb. | .455 / | 46 |
| Schenectady shell mold resins | lb. | .26 / | 28 |
| Synvar molding compounds, PM series | lb. | .205 / | .2625 |
| Synvaren 640 | lb. | .30 / | .335 |
| 920 | lb. | .21 / | .245 |
| 935 | lb. | .195 / | .23 |
| 9203, 9203A | lb. | .173 / | .208 |
| Synvaren liquid industrial resins: | | | |
| 675 | lb. | .29 / | .325 |
| 920 | lb. | .21 / | .245 |
| CP-66 | lb. | .19 / | .225 |
| PBL-2 | lb. | .33 / | .365 |
| PBL-218S | lb. | .27 / | .305 |
| Synvarite GW-1090 | lb. | .34 / | .36 |
| GW-1080, PBL-F, PBL-718 | lb. | .37 / | .39 |
| GW-2400 | lb. | .375 / | .395 |
| PBL-100 | lb. | .31 / | .33 |
| PBL-108FF | lb. | .38 / | .40 |
| PBL-210, PBL-3301 | lb. | .36 / | .38 |
| PBL-410 | lb. | .33 / | .35 |
| PBL-3311 | lb. | .35 / | .37 |
| PNL-12HL/11, PNL-156HL/24 | lb. | .3025/ | .3225 |
| PNL-159H, PNL-169H | lb. | .29 / | .31 |
| PNL-169PD, PNL-179PD | lb. | .28 / | .30 |
| PNL-355PD | lb. | .315 / | .335 |
| PNL-1279HL | lb. | .2875/ | .3075 |
| PT | lb. | .32 / | .34 |
| Teolplastik No. 8000 | lb. | .48 / | .72 |

**Polyamide**

| | | | |
|---|---|---|---|
| Fiberfil Nylon G, natural | lb. | 1.70 / | 1.90 |
| Standard colors | lb. | 1.80 / | 2.20 |
| Nylatron G5 | lb. | 1.28 | |
| Plaskon 8200, 8201 natural | lb. | 1.33 / | 1.50 |
| Black | lb. | 1.53 / | 1.70 |
| White | lb. | 1.43 / | 1.60 |
| Other colors | lb. | 1.63 / | 1.80 |
| Spencer Nylon 401, 402 | lb. | 1.18 / | 1.66 |
| 600, 603 | lb. | 1.18 / | 1.65 |
| 601 | lb. | 1.28 / | 1.45 |
| 602 | lb. | 1.33 / | 1.80 |
| 604, 606 | lb. | 1.28 / | 1.75 |
| Versamid 115 | lb. | .64 / | .82 |
| Zytel molding powder | lb. | 1.435 / | 1.60 |
| Zytel, natural color | lb. | 1.18 / | 1.35 |
| Blacks and whites | lb. | 1.43 / | 1.80 |
| Colors | lb. | 1.63 / | 2.05 |

**Polyesters**

| | | | |
|---|---|---|---|
| Acme 1-501 | lb. | .82 / | .93 |
| 1-501A | lb. | .87 / | .98 |
| 1-503 | lb. | 2.75 / | 3.50 |
| 1-510 | lb. | 89 / | 1.00 |
| Atlac 363E-02Z, -12Z | lb | 66 / | .69 |
| -32Z | lb | .68 / | .71 |
| 382E | lb | .57 / | .60 |
| FP | lb | .66 / | .69 |
| Bakelite Polyester resins | lb | 95 / | .75 |
| Diall 50-01 | lb. | 2.45 | |
| 50-51 | lb. | 3.25 / | 3.50 |
| 50-52 | lb. | 3.50 | |
| 51-01 | lb. | .87 / | 1.15 |
| 52-01 | lb. | 2.25 / | 2.50 |
| 52-20-30 | lb | 1.50 | |
| Diall 50-01, 50-51, 50-52 | lb. | $2.75 / | $3.50 |
| 51-01 | lb. | .87 / | .98 |
| 52-01 | lb. | 1.95 / | 2.50 |
| 52-20-30 | lb. | 1.30 / | 1.50 |
| Fibercore 1000, 2000 | lb. | .50 / | .63 |
| 3000 | lb. | .55 / | .70 |
| G E polyesters | | | |
| AR 401 | lb. | .35 / | .365 |
| AR 403, 480 | lb. | .34 / | .355 |
| AR 403 LS, 480 LS | lb. | .355 / | .37 |
| AR 493 | lb. | .40 / | .415 |
| AR 499 | lb. | .435 / | .45 |
| AR 501 | lb. | .455 / | .47 |
| Hetron 33 | lb. | .39 / | .405 |
| 32A | lb. | .435 / | .45 |
| 92 | lb. | .43 / | .445 |
| 93LS | lb. | .485 / | .50 |
| IC-312, -400, -514, -548, -625, -730, -800 | lb. | .35 / | .385 |
| -312-2 | lb. | .365 / | .38 |
| -336, -382, -706 | lb. | .37 / | .385 |
| -401 | lb. | .44 / | .455 |
| -420 | lb. | .355 / | .37 |
| -433 | lb. | .38 / | .395 |
| -636, -670 | lb. | .48 / | .495 |
| -638, -689 | lb. | .55 / | .565 |
| -670-2 | lb. | .50 / | .515 |
| -671 | lb. | .405 / | .42 |
| Filled resins | lb. | .255 / | .54 |
| Laminac 4110 | lb. | .33 / | .345 |
| 4111 | lb. | .45 / | .465 |
| 4116 | lb. | .33 / | .345 |
| 4120 | lb. | .39 / | .405 |
| 4123, 4128 | lb. | .34 / | .355 |
| 4134 | lb. | .46 / | .475 |
| 4146 | lb. | .43 / | .445 |
| 4192 | lb. | .355 / | .37 |
| 4202 | lb. | .55 / | .565 |
| Marco resins: | | | |
| CEL-101, Marcothix 1, 3 | lb. | .51 / | .525 |
| Marcothix 5, 7, 8 | lb. | .47 / | .485 |
| Marcothix 9, MR-31C, 28H, 41-R | lb. | .37 / | .385 |
| Marcothix 10, MR-28C, -28V, -31V, -37C, -37CX | lb. | .34 / | .355 |
| MR-28CS | lb. | .36 / | .375 |
| MR-28R, -42R | lb. | .35 / | .365 |
| MR-28RL, -37RL | lb. | .365 / | .38 |
| MR-30C | lb. | .45 / | .465 |
| MR-33C | lb. | .54 / | .555 |
| MR-40R | lb. | .39 / | .405 |
| MR-60C | lb. | .42 / | .435 |
| MR-61H | lb. | .43 / | .445 |
| Mylar, rolls, types A & C | lb. | 2.50 / | 4.80 |
| Type D | lb. | 3.00 / | 3.30 |
| Sheets, type A | M. sq. in. | .09 / | 1.11 |
| Type C | M. sq. in. | .09 / | .15 |
| Type D | M. sq. in. | .53 / | 1.34 |
| Plaskon 911, 920 | lb. | .55 / | .665 |
| 941, 942, 951, 9411 | lb. | .35 / | .463 |
| 943 | lb. | .41 / | .525 |
| 9404 | lb. | .365 / | .48 |
| 9406 | lb. | .355 / | .465 |
| 9500, 9510, 9511 | lb. | .35 / | .465 |
| 9600 | lb. | .44 / | .555 |
| Pleogen 1000, 1001, 1002, 1006, 1007, 1100, 1810 | lb. | .34 / | .355 |
| 1150, 1501 | lb. | .365 / | .375 |
| 1201 | lb. | .50 / | .51 |
| 1300, 1301 | lb. | .35 / | .36 |
| 1300LS, 1700, 1813 | lb. | .37 / | .38 |
| 1402 | lb. | .44 / | .45 |
| 1406 | lb. | .46 / | .47 |
| 1602 | lb. | .35 / | .365 |
| 1800, 1802 | lb. | .45 / | .46 |
| Polycast 2 | sq. ft. | 1.89 / | 3.18 |
| 3 | sq. ft. | 1.08 / | 18.00 |
| 6 | sq. ft. | .66 / | 3.10 |
| 7 | sq. ft. | .72 / | 7.18 |
| CR-39 | sq. ft. | 1.25 / | 20.00 |
| Polylite 8000, 8001, 8005, 8007, 8017, 8037, 8173, 8200 | lb. | .34 / | .355 |
| 8006, 8008, 8009, 8039, 8166 | lb. | .35 / | .365 |
| 8016, 8100 | lb. | .365 / | .38 |
| 8050 | lb. | .41 / | .425 |
| 8061, 8065 | lb. | .44 / | .455 |
| 8120 | lb. | .48 / | .495 |
| 8150 | lb. | .45 / | .465 |
| 8170, 8237 | lb. | .38 / | .395 |
| 8180, 8181 | lb. | .36 / | .375 |
| 8400 | lb. | .56 / | .575 |
| Pre-Imp | lb. | .68 / | .85 |
| Thermaflow 100, 200, 300 | lb. | .48 / | .82 |
| 400, 500 | lb. | .52 / | .87 |
| 1,000, 2,300 | lb. | .34 / | .55 |
| 2,400 | lb. | .36 / | .58 |
| Vibrin 114, 117, 132, 134 | lb. | .34 | |
| 115A | lb. | .38 | |
| 121 | lb. | .46 | |
| 135 | lb. | 3.00 | |
| 142 | lb. | .50 | |
| 151 | lb. | .35 | |
| 152LS-4 | lb. | .355 | |
| 153 | lb. | .40 | |
| X-1633-A | lb. | .49 | |
| X-1636-W | lb. | .585 | |

**Polyethylene**

| | | | |
|---|---|---|---|
| A-C No. 6, 617 | lb. | .30 / | .37 |
| No. 6A, 7, 617A | lb. | .35 / | .42 |
| No. 615, G-201 | lb. | .38 / | .45 |
| No. 629 | lb. | .40 / | .47 |
| No. 729 | lb. | .45 / | .52 |

| | | | |
|---|---|---|---|
| Alathons, Group I | lb. | $0.35 / | $0.43 |
| Group II | lb. | .37 / | .515 |
| Group III | lb. | .375 / | .42 |
| Bakelite DE Series | lb. | .43 / | .725 |
| DVGT | lb. | .54 / | .69 |
| DYLT, DYNF, DYNH | lb. | .41 / | .59 |
| DYNJ | lb. | .44 / | .62 |
| DYNK | lb. | .45 / | .63 |
| Catalin 15-5 | lb. | .41 / | .59 |
| Fortiflex A-20, 70, 250, 500, nat. | lb. | .47 / | .50 |
| colors | lb. | .53 / | 1.10 |
| black | lb. | .495 / | .525 |
| Grex, nat. | lb. | .43 / | .47 |
| gen. purpose black | lb. | .455 / | .495 |
| colors and special purpose black | lb. | .49 / | 1.06 |
| Hi-fax, nat. | lb. | .43 / | .47 |
| colors | lb. | .49 / | 1.06 |
| General purpose blacks | lb. | .455 / | .495 |
| pipe blacks | lb. | .475 / | .515 |
| electrical grade | lb. | .49 / | .57 |
| monofilament | lb. | .43 / | .47 |
| Marlex, types 2, 9, 15, 35, 50: | | | |
| Black, general purpose | lb. | .455 / | .495 |
| High dispersion and plain | lb. | .49 / | 1.06 |
| Natural | lb. | .43 / | .47 |
| With special antioxidants | lb. | .45 / | .49 |
| Petrothene 100, 101, 200, 202, 203, 205, 206, 207, 208, 301 | lb. | .35 / | .45 |
| 300, 300-200 | lb. | .465 / | .565 |
| 300-6 | lb. | .425 / | .525 |
| 301, electrical grade | lb. | .41 / | .51 |
| 301-6 | lb. | .37 / | .47 |
| 301-200, 301-202, 302-506, 560 | lb. | .375 / | .48 |
| 302-6 | lb. | .39 / | .49 |
| Poly-Eth 1005, 1007, 1085, 1009, 1105, 1407, 1408.5, 2007, 2205, 2215, 2235, 2206, 2226, 2236, 2256, 2405, 2425, 2976, 2477 | lb. | .35 / | .49 |
| 3215 | lb. | .37 / | .51 |
| 3226, 3405 | lb. | .375 / | .515 |
| 3495 | lb. | .50 / | .64 |
| Hi-D 1504, 2504, 3504 | lb. | .45 / | .56 |
| Reynolon 1000, P series | lb. | 60 / | .80 |
| Rulan 2 | lb. | .48 / | .52 |
| Tenite Group 1 | lb. | .41 / | .45 |
| Group 2 | lb. | .43 / | .47 |
| Group 3 | lb. | .46 / | .50 |
| Group 4 | lb. | .39 / | .43 |
| Group 5, 6 | lb. | .50 / | .72 |
| Group 7 | lb. | .60 / | .82 |
| Group 8 | lb. | .70 / | .92 |

## Polypropylene

| | | | |
|---|---|---|---|
| Moplen, natural | lb. | .56 / | .62 |
| Standard colors | lb. | .65 / | .92 |
| Pro-Fax, natural | lb. | .56 / | .62 |
| Standard colors | lb. | .65 / | .92 |

## Silicone

| | | | |
|---|---|---|---|
| Bakelite GMGA-5001, -5002 | lb. | 2.75 / | 3.10 |
| 5003 | lb. | 4.00 / | 4.35 |
| 5004 | lb. | 5.40 / | 5.75 |
| Dow Corning 301 | lb. | 3.60 / | 4.00 |
| 2103 | lb. | 1.55 / | 1.65 |
| 2105, 2106 | lb. | 1.59 / | 1.70 |

## Styrenes

| | | | |
|---|---|---|---|
| Ampacet, crystal | lb. | .318 / | .335 |
| Colors, std. | lb. | .345 / | .363 |
| Special | lb. | .345 / | .75 |
| Pearl | lb. | .41 / | .75 |
| Phosphorescent | lb. | .695 / | 1.00 |
| Tinsel | lb. | .41 / | .67 |
| Confetti | lb. | .51 / | .70 |
| Bakelite BMC series, nat. | lb. | .45 / | .685 |
| Colors | lb. | .50 / | .735 |
| BMS, SMD series, crystal | lb. | .295 / | .31 |
| Colors, std. | lb. | .335 / | .35 |
| Special | lb. | .335 / | .52 |
| RMD series, nat. | lb. | .45 / | .685 |
| Colors | lb. | .50 / | .735 |
| TGD series | lb. | .33 / | .35 |
| Colors, std. | lb. | .36 / | .38 |
| Special | lb. | .36 / | 1.00 |
| TMD series | lb. | .33 / | .40 |
| Colors, std. | lb. | .36 / | .43 |
| Special | lb. | .36 / | 1.00 |
| Catalin, high impact, natural | lb. | .325 / | .355 |
| Colors, std. | lb. | .355 / | .385 |
| Special | lb. | .36 / | 1.00 |
| Medium impact, natural | lb. | .325 / | .355 |
| Colors, std. | lb. | .355 / | .385 |
| Special | lb. | .355 / | 1.00 |
| Regular grade, crystal | lb. | .305 / | .325 |
| Colors, std. | lb. | .345 / | .365 |
| Special | lb. | .345 / | 1.00 |
| Utility black | lb. | .18 / | .235 |
| Cycolac compounds: | | | |
| Natural powders | lb. | .53 / | .65 |
| Natural & std. color pellets | lb. | .58 / | .62 |
| Darex Copolymer 3 | lb. | .47 / | .67 |
| 43G | lb. | .39 / | .58 |
| X34 | lb. | .42 / | .61 |
| Latices 3L | lb. | .415 / | .56 |
| 610L | lb. | .30 / | .46 |
| 3020 | lb. | .32 / | .47 |
| Dow Latex: styrene/ butadiene | lb. | .295 / | .57 |
| Resins PS-2&3 | lb. | $0.25 / | $0.35 |
| butadiene | lb. | .30 / | .46 |
| Dylite, expandable beads | lb. | .50 / | .60 |
| Fiberfil Styrene G, natural | lb. | .55 / | 1.00 |
| Standard colors | lb. | .65 / | 2.00 |
| Koppers, Fibertuff | lb. | .55 / | 1.505 |
| MC-185 series | lb. | .33 / | .355 |
| -300 series | lb. | .33 / | 1.005 |
| -400 series | lb. | .355 / | 1.005 |
| Regular, crystal | lb. | .295 / | .315 |
| Colors, std. | lb. | .335 / | .355 |
| Special | lb. | .335 / | 1.005 |
| Pearl | lb. | .41 / | 1.005 |
| Phosphorescent | lb. | .695 / | 2.005 |
| Kralastic, std. colors | lb. | .50 / | 1.10 |
| Lustrex Hi-Flows 55, 66, 77, and Hi-Heat 99 crystals | lb. | .26 / | .275 |
| LHA standard colors | lb. | .34 / | .365 |
| special colors | lb. | .34 / | 1.00 |
| Hi-Test 88 & 89 | lb. | | |
| Natural & 844 black | lb. | .32 / | .34 |
| standard colors | lb. | .345 / | .385 |
| special colors | lb. | .345 / | 1.00 |
| Marbon resins | lb. | .39 / | .46 |
| Plio-Tuf C75, R100 | lb. | .37 / | .45 |
| G85 | lb. | .52 / | .59 |
| P100, std. colors | lb. | .41 / | .45 |
| Polycast 4 | sq. ft. | 2.56 / | 11.07 |
| Styron 475, natural | lb. | .33 / | .35 |
| Colors, std. | lb. | .36 / | .38 |
| Special | lb. | .36 / | 1.00 |
| Sheets, std. | lb. | .55 / | .60 |
| Special | lb. | .55 / | .62 |
| 480, natural black | lb. | .38 / | .40 |
| Colors, std. | lb. | .41 / | .43 |
| Special | lb. | .41 / | 1.00 |
| 647, crystal | lb. | .305 / | .32 |
| Colors, special | lb. | .345 / | 1.34 |
| 66, 688, crystal | lb. | .295 / | .31 |
| Colors, std. | lb. | .335 / | .35 |
| Special | lb. | .335 / | 1.00 |
| 700, crystal | lb. | .295 / | .31 |
| Colors, std. | lb. | .335 / | .35 |
| Special | lb. | .335 / | 1.00 |
| 777 colors, std. | lb. | .355 / | .375 |
| Special | lb. | .355 / | 1.00 |

## Urea

| | | | |
|---|---|---|---|
| Admirez Foundry Resins, SP-30 | lb. | .27 | |
| UP-50 | lb. | .105 | |
| Beetle C-4980 Brown | lb. | .1875/ | .30 |
| No fines granulation | lb. | .2075/ | .32 |
| T-298 Black | lb. | .1875/ | .30 |
| MUP series, powder | lb. | .30 / | .49 |
| Special colors | lb. | .30 / | .59 |
| Granules | lb. | .33 / | .52 |
| Special colors | lb. | .33 / | .62 |
| Foundrez core binder | lb. | .105 / | .14 |
| Plaskon molding cmpds.: | | | |
| Black & Brown | lb. | .1875/ | .30 |
| Other colors | lb. | .30 / | .62 |
| Foundry resins, liquid | lb. | .10 / | .13 |
| Powdered | lb. | .2325/ | .2525 |
| Sylplast molding cmpds., granules | lb. | .33 | |
| Powder | lb. | .30 | |

## Vinyls

| | | | |
|---|---|---|---|
| Bakelite QG-5900 | lb. | .35 / | .585 |
| QG-5921 | lb. | .41 / | .645 |
| 5924 | lb. | .43 / | .665 |
| QYNA, QYSM, QYSQ | lb. | .27 / | .47 |
| QYNV | lb. | .30 / | .50 |
| QYSJ | lb. | .28 / | .48 |
| VG-1914, 1918 | lb. | .37 / | .056 |
| 1985 | lb. | .35 / | .585 |
| 5507 | lb. | .31 / | .545 |
| 5544 | lb. | .405 / | .64 |
| 5911 | lb. | .315 / | .55 |
| 5980 | lb. | .32 / | .555 |
| 7734 | lb. | .28 / | .515 |
| 9031 | lb. | .265 / | .50 |
| 9530 | lb. | .275 / | .51 |
| 9960, 9970, 9980 | lb. | .335 / | .57 |
| VAGH | lb. | .55 / | .75 |
| VMCH | lb. | .41 / | .61 |
| VYDR, VYNW | lb. | .27 / | .47 |
| VYHH | lb. | .32 / | .52 |
| VYLF | lb. | .36 / | .56 |
| VYNS | lb. | .44 / | .64 |
| VYNV | lb. | .32 / | .52 |
| Blacar No. BW-60 | lb. | .315 / | .385 |
| NEMA colors | lb. | .355 / | .425 |
| No. BW-80 | lb. | .405 / | .455 |
| NEMA colors | lb. | .445 / | .495 |
| No. PC white, ivory, black | lb. | .285 / | .335 |
| Other colors | lb. | .325 / | .375 |
| Celanese Chemulsions 100, 101, 102 | lb. | .18 / | .275 |
| 201, 202 | lb. | .20 / | .295 |
| Darex Everplex A (wet wt.) | lb. | .21 / | .39 |
| B (wet wt.) | lb. | .22 / | .40 |
| G (wet wt.) | lb. | .21 / | .39 |
| Copolymer V (wet wt.) | lb. | .245 / | .28 |
| PVA Emulsions (wet wt.) | lb. | .19 / | .355 |
| Diamond PVC-45, -50 | lb. | .27 / | .33 |
| Dow PVC 100 -111 | lb. | .38 / | .57 |
| Du Pont Elvanol 50-42 | lb. | .83 | |
| 51-05, 71-30 | lb. | .64 | |
| 52-22 | lb. | .75 | |
| 72-60 | lb. | .57 | |
| Escambia Pearls, 2185, 2200, 2225, 2250 | lb. | $0.27 / | $0.47 |
| Exon 402A, 500, 905, 915, 925 | lb. | .27 / | .47 |
| 450, 468, 480 | lb. | .32 / | .52 |
| 461 | lb. | 9.75 | |
| 470 | lb. | .48 / | .68 |
| 471 | lb. | .45 / | .65 |
| 481 | lb. | .39 / | .59 |
| 485 | lb. | .37 / | .57 |
| 654 | lb. | .30 / | .50 |
| Formvar | lb. | .865 / | 1.03 |
| Gelva emulsions | lb. | .19 / | .205 |
| Granules | lb. | .4175/ | .617 |
| Geon 101, 101EP, 103EP, 202 | lb. | .27 / | .45 |
| 121 | lb. | .30 / | .48 |
| 126 | lb. | .28 / | .46 |
| 400X110 | lb. | .41 / | .59 |
| 404HI | lb. | .37 / | .55 |
| 409, 426, 427, 428 | lb. | .32 / | .50 |
| 503H (polyblend) | lb. | .425 / | .525 |
| 2042, 2046 | lb. | .315 / | .55 |
| Colors | lb. | .365 / | .60 |
| 6373 | lb. | .345 / | .58 |
| Colors | lb. | .395 / | .63 |
| 6461 | lb. | .325 / | .56 |
| Colors | lb. | .375 / | .61 |
| 8372 | lb. | .33 / | .565 |
| Colors | lb. | .38 / | .615 |
| 8539, 8726 | lb. | .33 / | .565 |
| Colors | lb. | .35 / | .585 |
| 8590, 8591, 8592, 8593 8594, 8595 | lb. | 2.00 / | 2.75 |
| 8600 | lb. | .275 / | .51 |
| Colors | lb. | .325 / | .56 |
| 8620 | lb. | .27 / | .505 |
| Colors | lb. | .32 / | .555 |
| 8630 | lb. | .425 / | .66 |
| Colors | lb. | .475 / | .71 |
| 8640 | lb. | .35 / | .585 |
| 8650 | lb. | .32 / | .555 |
| 8677 | lb. | .435 / | .67 |
| 8700A, 8750 | lb. | .425 / | .66 |
| Colors | lb. | .455 / | .69 |
| 8720 | lb. | .605 / | .84 |
| 8737 | lb. | .33 / | .565 |
| 8740 | lb. | .295 / | .53 |
| 8749 | lb. | .29 / | .525 |
| 8800 | lb. | .44 / | .675 |
| 8801 | lb. | .275 / | .51 |
| Colors | lb. | .325 / | .56 |
| 8802 | lb. | .33 / | .565 |
| Colors | lb. | .38 / | .615 |
| 8804 | lb. | .29 / | .525 |
| 8807 | lb. | .45 / | .685 |
| 8809 | lb. | .37 / | .605 |
| 8810 | lb. | .275 / | .55 |
| 8812, 8813, 8814, 8815 | lb. | .315 / | .51 |
| Geon Latex 151, 251 | lb. | .26 / | .32 |
| 351 | lb. | .32 / | .38 |
| 352 | lb. | .28 / | .34 |
| 552, 652 | lb. | .37 / | .43 |
| 450x167 | lb. | .39 / | .45 |
| 576 | lb. | .365 / | .40 |
| Krene, film | lb. | .505 / | .655 |
| Sheeting | lb. | .49 / | .645 |
| Marvinols: | | | |
| NF-1005 | lb. | .34 / | .625 |
| NF-1055, 3520 | lb. | .275 / | .565 |
| NF-3020 | lb. | .41 / | .645 |
| NF-3025 | lb. | .38 / | .6625 |
| NF-3040 | lb. | .3375/ | .625 |
| NF-3045, 3050 | lb. | .37 / | .60 |
| NF-3055 | lb. | .285 / | .575 |
| NF-3060 | lb. | .29 / | .575 |
| NF-3065 | lb. | .30 / | .58 |
| NF-3070, 3075, 3080 | | .265 / | .505 |
| NF-3085, 3090, 3095 | lb. | .29 / | .525 |
| NF-3505, 3515 | lb. | .36 / | .595 |
| NF-3510 | lb. | .34 / | .575 |
| NF-4005 | lb. | .44 / | .675 |
| NF-4010, 4015, 4020 | lb. | .42 / | .705 |
| NF-5015, 5020 | lb. | .40 / | .655 |
| NF-5025 | lb. | .33 / | .585 |
| NF-5030 | lb. | .29 / | .545 |
| NR-6015 | lb. | .39 / | .685 |
| NR-6020 | lb. | .39 / | .675 |
| NR-7002, 7045, 7060 | lb. | .50 / | .73 |
| VR-10 | lb. | .28 / | .47 |
| VR-12, -20, -21, -22, -24, -30 | lb. | .27 / | .46 |
| VR-50 | lb. | .30 / | .49 |
| Opalon 410 | lb. | .30 / | .50 |
| 505, 510 | lb. | .32 / | .52 |
| 1006 | lb. | .315 / | .55 |
| 1018 | lb. | .28 / | .515 |
| 1028, 1038, 72217, 75167, 75223 | lb. | .33 / | .565 |
| 1308 | lb. | .27 / | .505 |
| 1406 | lb. | .415 / | .465 |
| 1706 | lb. | .385 / | .62 |
| 71329 | lb. | .275 / | .51 |
| 72285 | lb. | .3375/ | .5725 |
| 75179 | lb. | .335 / | .57 |
| 78096 | lb. | .395 / | .63 |
| 78197 | lb. | .32 / | .55 |
| 78207 | lb. | .29 / | .525 |
| 78210, 78211 | lb. | .335 / | .57 |
| 78216 | lb. | .31 / | .545 |
| 78343 | lb. | .285 / | .52 |
| Plastiflex, std. | lb. | .90 / | 1.10 |
| Novelty | lb. | 1.15 / | 1.50 |
| Pliovic AO (dispersion) | lb. | .30 / | .32 |
| DB80V, DB90V, EDB90V | lb. | .27 / | .29 |
| Latex 300 | lb. | .30 / | .35 |

| | | | |
|---|---|---|---|
| Reynolon PVA/4-6, roll stock 1 mill | lb. | $1.85 | / $3.25 |
| 1½, 2, 3, 4, 5, 6, 8 mill | lb. | 1.60 | / 3.00 |
| Satinflex | lb. | 1.15 | / 1.50 |
| Vygen 110, 120 | lb. | .27 | / .31 |
| 1101, 1150 | lb. | .425 | / .50 |
| 2201 | lb. | .48 | / .55 |
| Vinac RP-250 | lb. | .55 | / 1.03 |

### Vinylidine

| | | | |
|---|---|---|---|
| Dow Latex 744-B | lb. | .26 | / .42 |
| Resin 565 | lb. | .39 | / .525 |
| Saran formulation 115, black, nat. | lb. | .39 | / .52 |
| Colors | lb. | .44 | / .69 |
| 720 nat. | lb. | .41 | / .54 |
| Colors | lb. | .46 | / .71 |
| 747 nat. | lb. | .395 | / .525 |
| 761 nat. | lb. | .39 | / .52 |
| Colors | lb. | .44 | / .69 |
| 820 nat. | lb. | .42 | / .55 |
| Colors | lb. | .47 | / .6C |
| Latices | lb. | .45 | / .61 |
| Resin F 120 | lb. | .58 | / .65 |
| F242 | lb. | .64 | / .70 |

### Solvents

| | | | |
|---|---|---|---|
| Eccostrip 57 | lb. | 1.50 | |
| Enjay acetone | lb. | .085 | / .12 |
| Ethyl ester | gal. | .44 | |
| Isopropyl acetate | lb. | .115 | / .15 |
| Isopropyl alcohol 91% | gal. | .37 | / .60 |
| 95% | gal. | .39 | / .62 |
| Anhydrous | gal. | .41 | / .64 |
| Isopropyl ether | gal. | .30 | / .51 |
| Methyl ethyl ketone | lb. | .125 | / .16 |
| Secondary butyl acetate | lb. | .1225 | / .1575 |
| Secondary butyl alcohol | lb. | .125 | / .16 |

### Stabilizers

| | | | |
|---|---|---|---|
| Advastab B-13-P, BC-105, BC-147 | lb. | .75 | / .80 |
| BC-12, C-77, C-79, E-82 | lb. | .90 | / .95 |
| BC-74, BC-30 | lb. | .70 | / .75 |
| BZ-51, L paste, Z-6, Z-15 | lb. | .65 | / .70 |
| BZ-155 | lb. | .69 | / .74 |
| C-21 | lb. | 1.00 | / 1.05 |
| CH-101, CH-201 | lb. | .60 | / .65 |
| CZ-11 | lb. | .95 | / 1.00 |
| E-98 | lb. | .53 | / .58 |
| JCX | lb. | .62 | / .67 |
| SN | lb. | .47 | / .52 |
| T-10, T-52 | lb. | 1.90 | / 1.95 |
| T-17M | lb. | 2.95 | / 3.00 |
| T-50LT | lb. | 3.20 | / 3.25 |
| T-52N | lb. | 1.80 | / 1.85 |
| T-72, T-671 | lb. | 2.65 | / 2.70 |
| Thermolite Mark C | lb. | .88 | / .95 |
| B | lb. | .72 | / .85 |
| M | lb. | .68 | / .74 |
| PL | lb. | .63 | / .69 |
| TT | lb. | .72 | / .86 |
| WS | lb. | .98 | / 1.11 |
| X | lb. | 2.50 | / 2.75 |
| XI | lb. | $.87 | / $1.01 |
| XV | lb. | .92 | / .99 |
| XX | lb. | .58 | / .65 |
| Barca 10 | lb. | .75 | / .80 |
| Baker barium ricinoleate | lb. | .70 | |
| Calcium ricinoleate | lb. | .55 | |
| Zinc vicinoleate | lb. | .60 | |
| Dutch Boy Barinac | lb. | .70 | |
| Calstar | lb. | .37 | |
| Clarite A | lb. | .83 | |
| B | lb. | .68 | |
| CS-137 | lb. | 1.25 | |
| DS-207 | lb. | .55 | |
| Dyphos | lb. | .58 | / .595 |
| 50A | lb. | .34 | |
| Dythal | lb. | .395 | / .41 |
| Leadstar | lb. | .39 | |
| Lectro 60 | lb. | .2525 | |
| Normal lead maleate | lb. | .4475 | |
| Normasal | lb. | .46 | |
| Pearleacent pigment | lb. | 1.00 | |
| Plumb-O-Sil-A | lb. | .3075 | |
| -B | lb. | .325 | / 0.37 |
| -C | lb. | .3475 | / .375 |
| Provinite A | lb. | .83 | |
| B | lb. | .68 | |
| Tribase | lb. | .275 | |
| -E | lb. | .2225 | |
| Trimal | lb. | .435 | |
| Ferro 182 | lb. | .70 | / .76 |
| 200 | lb. | 1.31 | / 1.43 |
| 203, 900, 1820 | lb. | .88 | / 1.00 |
| 503 | lb. | .28 | / .40 |
| 541A | lb. | .80 | / .92 |
| 700 | lb. | .47 | / .59 |
| 703, 1972 | lb. | .63 | / .75 |
| 823 | lb. | 2.50 | / 2.75 |
| 840 | lb. | 3.25 | |
| 903 | lb. | .58 | / .70 |
| 909 | lb. | .91 | / 1.01 |
| 1203 | lb. | 1.30 | / 1.40 |
| 1206 | lb. | 1.23 | / 1.33 |
| 1212 | lb. | .68 | / .80 |
| 1825 | lb. | .98 | / 1.10 |
| 1840 | lb. | .73 | / .85 |
| 1976 | lb. | .45 | / .57 |
| Harshaw 1-V-3 | lb. | .43 | / .45 |
| 1-V-4 | lb. | .665 | / .70 |
| 1-V-7, 1-V-26 | lb. | .66 | / .68 |
| 2-V-4 | lb. | .85 | / .87 |
| 2-V-5 | lb. | 1.09 | / 1.12 |
| 5-V-1 | lb. | .41 | / .43 |
| 7-V-2 | lb. | .93 | / .95 |
| 8-V-1 | lb. | .88 | / .90 |
| 8-V-21 | lb. | .63 | / .65 |
| 8-V-100, 10-V-442 | lb. | .82 | / .84 |
| 9-V-1 | lb. | .70 | / .72 |
| 12-V-5 | lb. | .73 | / .75 |
| 12-V-6 | lb. | .92 | / .94 |
| 12-V-63 | lb. | .72 | / .74 |
| 12-V-64 | lb. | .68 | / .70 |
| 19-V-1 | lb. | .52 | / .54 |
| 24-V-1 | lb. | 1.10 | / 1.12 |
| 128-V-5 | lb. | .86 | / .88 |
| Merix AST Concentrate 1001 | lb. | .355 | / 1.75 |
| Metasap 613-A | lb. | .69 | |
| 613-B | lb. | .84 | |
| 613-C | lb. | $1.06 | |
| 621 | lb. | .88 | |
| 624 | lb. | .75 | |
| Cadmium stearate | lb. | 1.40 | / $01.44 |
| Fused stearates, calcium 602-A | lb. | .25 | / .30 |
| Dibasic lead stearate | lb. | .55 | / .60 |
| Lead 611 | lb. | .32 | / .38 |
| Lead stearate | lb. | .43 | / .47 |
| Nuostable V-1 | lb. | .54 | / .59 |
| V-2 | lb. | .39 | / .44 |
| V-10 | lb. | .70 | / .75 |
| V-20 | lb. | 1.30 | / 1.35 |
| V-21 | lb. | 1.29 | / 1.34 |
| V-30 | lb. | .90 | / .95 |
| V-31 | lb. | .80 | / .85 |
| V-40 | lb. | .18 | / 1.23 |
| V-42 | lb. | .65 | / .70 |
| V-43 | lb. | .75 | / .80 |
| V-44 | lb. | .90 | / .95 |
| V-45 | lb. | 1.10 | / 1.15 |
| V-50 | lb. | .49 | / .54 |
| V-60 | lb. | .37 | / .42 |
| V-70 | lb. | .68 | / .73 |
| V-80 | lb. | 2.80 | / 2.85 |
| V-81 | lb. | 2.90 | / 2.95 |
| Permyl A | lb. | .45 | / .57 |
| Stabelan E | lb. | 1.40 | / 1.50 |
| HR, liquid | lb. | .65 | / .75 |
| Paste | lb. | .85 | / .95 |
| Powder | lb. | .95 | / 1.05 |
| XL | lb. | .55 | / .65 |
| Staflex QMXA | lb. | .70 | |
| 50% in DOP | lb. | .52 | |
| OY | lb. | 1.00 | / 1.20 |
| Stayrite #10 | lb. | .33 | / .37 |
| #15 | lb. | .54 | / .57 |
| #20 | lb. | .38 | / .42 |
| #22 | lb. | 1.32 | / 1.34 |
| #25 | lb. | .36 | / .46 |
| #70, 75, 80, 90 | lb. | .69 | / .70 |
| #229 | lb. | .47 | / .50 |
| P-10 | lb. | .40 | / .44 |
| Thermolite 12 | lb. | 2.00 | / 2.25 |
| 13 | lb. | 3.10 | / 3.78 |
| 15 | lb. | 4.13 | |
| 17 | lb. | 2.45 | / 2.75 |
| 20 | lb. | 2.95 | / 3.25 |
| 39 | lb. | 2.75 | / 3.25 |
| 91 | lb. | 3.00 | |
| Vanstay A | lb. | .51 | / .53 |
| AB | lb. | .47 | / .49 |
| HT | lb. | .88 | / .90 |
| HTA | lb. | .98 | / 1.00 |
| HTB | lb. | .71 | / .73 |
| HTC | lb. | 1.10 | / 1.12 |
| L | lb. | .33 | / .35 |
| R, X | lb. | .68 | / .70 |
| RZ-25 | lb. | .67 | / .69 |
| S | lb. | .58 | / .60 |
| SA | lb. | .82 | / .84 |
| W | lb. | 1.23 | / 1.25 |
| Z | lb. | .63 | / .65 |

### Wetting Agents

| | | | |
|---|---|---|---|
| Advawet 212 | lb. | .45 | / .50 |
| Merix Wash Concentrate | lb. | 2.59 | / 3.69 |
| Poly-lube No. 4 | gl. | 1.45 | / 1.94 |

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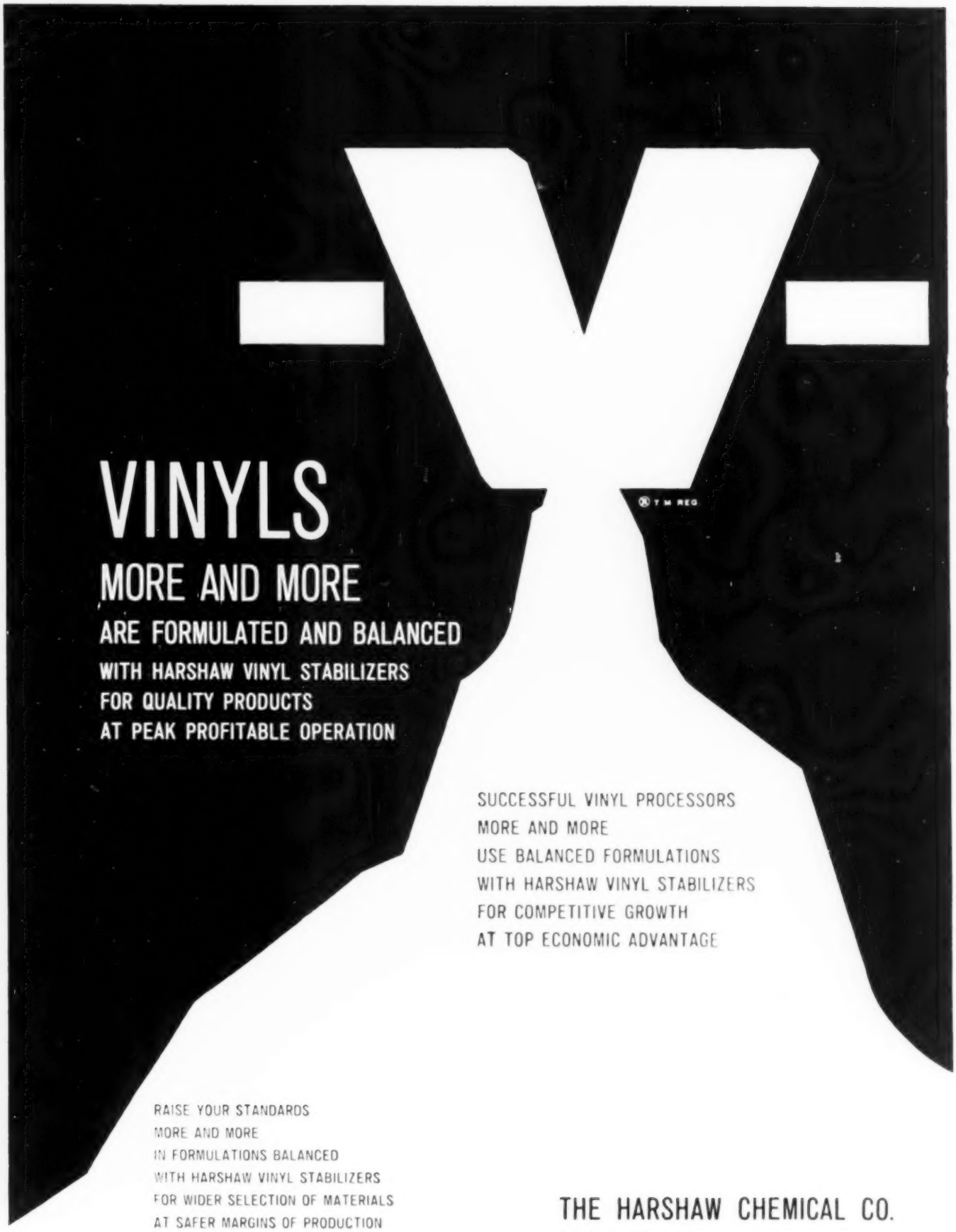


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